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DIV. INSECTS

CONTRIBUTIONS

FROM THE

DEPARTMENT OF

ZOOLOGY AND ENTOMOLOGY

Iowa State College of Agriculture
and Mechanic Arts.

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OBSERVATIONS ON THE CICADIDÆ OF IOWA. HERBERT OSBORN.
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A STUDY OF THE GENUS CLASTOPTERA.

ELMER D. BALL.

In the development of the hind tibiae and the structure and venation of the wings, the insects under consideration represent the highest and most specialized forms of the Cercopidæ if not of the Homoptera; marking, as Uhler suggests, an important advance toward the Heteroptera in the increased freedom of the anterior coxae and the possession of a terminal membrane to the corium.

In order to correctly establish generic characters it will be necessary, first, to separate off those of family value.

FAMILY CERCOPIDÆ.

The representatives of the family in this country, at least, agree in possessing the following characters:

Front inflated, convex or compresso produced; antennae inserted in front of and between the eyes; ocelli, two, situated on the disc of the vertex; thorax large, sexangular or trapezoidal; hemelytra coriaceous; posterior coxæ and femurs short, tibiæ spatulate, armed with two spurs, the first once, the second twice as long as tibiæ are wide; tibiæ and two first joints of tarsi terminated with crescent-shaped rows of spines, third joint with a bifid claw.

The following genera are represented in the United States: *Monecphora*, *Lepyronia*, *Aphrophora*, *Philaenus* and *Clastoptera*. These may be easily separated by the character of the venation of either pair of wings by reference to plate XII.

The *Clastoptera* may be separated from the others, directly, by the rounded apex of the clavus and the terminal membrane of the corium.

CLASTOPTERA.

Germar's original description published in his "Zeitschrift fur Entomologie," Vol. I, p. 157, is as follows:

> Kopf gross, stumpf dreieckig, so breit wie der Vorderrucken, Stirn gewolbt, queerstreifig, Scheitel breit viereckig, vorn und hinten scharf gerandet, die Nebenaugen auf der mitte des Scheitels genahert. Schnabel bis an die Hinterbrust reichend. Fuhler in einer Grube an der Wurzel der Wangen, sehr kurz, mit langer feiner Endborste. Vorderrucken breit am Scheitel vorgezogen und gerundet, bei den Augen gebuchtet, von den Schultern nach hinten in einer Rundung verschmalert, an der spitze schmal aber tief ausgerandet. Schildchen ein langgezogenes spitzwinkeliges dreick bildend. Deckschilde lederartig, an der Spitze gewolbt, uber einander klapfend, die hintere Randader weit von dem Hinterrande entfernt. Flugel hautig, unter den Deckschilden vorborgen. Beine maszig lang, unbewehrt um die hintersten verlangert, mit zwei stacheln am Rucken die Schienen und einem Dornenkranze an der Spitze der Schienen, und ersten beiden Tarsengliedern.

A careful study of all the American forms leads to the following summary of characters:

> Broad, oval forms; very variable in size and color markings; front inflated, circular, not longitudinally carinated; antennæ arising from a deep cavity between the eyes, basal enlargement not extending outside of cavity; vertex narrow, transversely depressed, outline regular, not inclosing front; eyes broad, a row of curved hairs on the outer and posterior margin; pronotum convex, trapezoidal, transversely wrinkled, deeply emarginated behind; scutellum narrow, triangular, longer than pronotum; hemelytra convex, deflected posteriorly, overlapping behind in a perpendicular plane; corium with three apical cells and two widely separated discoid cells, a broad membrane beyond; membrane and apical cellules hyaline; clavus with apex broadly rounded; an oval, convex, callous dot near apex of hemelytra; under wing with a single discoid cell, terminal apical cell open; posterior tibia with a single terminal row of spines: ovipositor carried perpendicular to the plane of the body; males usually smaller and slightly darker than females; smallest varieties nearly black.

Specific characters are based upon the size and shape of front, the facial angle, sculpturing of vertex and pronotum, size and shape of discoid and apical cells, pubescence of pronotum and hemelytra, and the color markings of the face and legs.

Sub-species are based upon size, food habits and associated groups of constant color markings; varieties, on locality, size and color markings of vertex, pronotum and clavus.

SYNOPSIS OF SPECIES.

A. Front strongly inflated, rising abruptly from face at sides, meeting vertex in same plane; pronotum with broad wrinkles; first discoid cell equal to second.

B. Front, outline a regular curve, entirely black, or yellow with transverse interrupted brown bands above, light below; pronotum scabrous, with about eight distinct wrinkles; veins on clavus prominent---------------------------------*delicata*, Uhl.

BB. Front, outline an irregular curve, upper half black with a narrow yellow margin next to vertex, lower half yellow, loræ and clypeus yellow; pronotum, bare, with about twelve indistinct broad wrinkles--------------------------------*proteus*, Fitch.

AA. Front, less inflated, rising gradually from face at sides, meeting vertex at an obtuse angle above; pronotum finely, sharply wrinkled, about twenty on the median line; first discoid cell smaller than second.

B. Hemelytra strongly impunctured, sparsely pubescent; second apical cell short and broad; insects small, of a uniform color above --*xanthocephala*, Germ.

BB. Hemelytra minutely impunctured, thickly finely pubescent, second apical cell long and narrow; insects large, usually banded above ---*obtusa*, Say.

ARTIFICIAL KEY TO SPECIES.

A. Face entirely black-------------*delicata-lineata*, var. *b.* or *binotata.*

AA. Face not entirely black.

B. Upper half of front black; loræ, clypeus and lower half of front yellow ---*proteus.*

BB. Upper half of front light with transverse, interrupted, brown bands.

C. Pronotum with five transverse straight black bands, not parallel with anterior margin---------*delicata-lineata*, var. *a.*

CC. Bands on pronotum parallel to anterior margin or wanting.

D. Hemelytra strongly impunctured, sparsely pubescent; pronotum without bands; lower half of face with a light band; insects small-----------*xanthocephala.*

DD. Hemelytra minutely impunctured thickly, finely pubescent; pronotum generally banded or colored where not, face all light; insects large------------*obtusa.*

C. DELICATA UHL.

C. binotata Uhl. ms.

Uhler's original description found in his list of Hemiptera west of the Mississippi river is as follows:

> Form of *C. proteus*, Fitch, but with a more prominent front. Pale greenish-yellow. Head broad, apparently impunctate; cranium short, transversely depressed, as is also the tylus; anterior edge of the vertex carinately elevated, bordered from eye to eye with a black line; eye margined behind with black; front smooth, polished, bright yellow, rounded, the transverse rugæ substituted by slender black bands; lower down grooved, and with a broad black spot, adjoining which each side on the cheeks is a smaller spot;

under side bright yellow; rostrum black, reaching almost to the posterior coxæ; antennæ black at base. Pronotum banded on the anterior margin by a slender black line, and with five straighter and more slender lines which stop just short of the lateral margins, these lines feebly impressed and obsoletely, minutely scabrous, surface not wrinkled, almost smooth, moderately convex, deeply emarginated behind, the lateral margin narrowly produced as far as the outer line of the eyes; the humeral margin recurved, and with a small black dot before it. Scutellum pubescent, yellow, transversely wrinkled, with a slender black line at base, and an interrupted one behind the middle. Hemelytra with short, remote, golden pubescence, coarsely punctate at base, more obsoletely so posteriorly; the inner and posterior margins, the suture between the corium and clavus, an oblique short streak on the disc, and a spot on the middle of the costa fuscous: posterior margin of the corium with a sinuous brown band, the membrane and posterior one-third of the corium, and spot at base of costa pale brown; the bulla very prominent, black; under side yellow; the mesostethium, discs of the plural pieces, and middle line of genital segment pitch black Legs, yellow, the tibiæ having a band below the knee, another on the middle, and a third at tip, and the spines of tibiæ and tarsi, including the nails, dark piceous.

Length to the tip of hemelytra, four and one-half mm., width of pronotum, two mm.

After a careful study of representatives from every state from which it has been reported so far, the following description, embracing only characters of specific value was prepared.

Size variable; color from yellow to black; front much inflated; two circular yellow depressions on vertex near eyes; pronotum strongly, broadly wrinkled.

Front rising abruptly from face at sides, meeting vertex in same plane above, outline a regular curve. Vertex very slightly transversely depressed; a distinct, circular, yellow depression midway between eye and ocellus on either side. Pronotum coarsely pubescent, strongly, transversely, wrinkled, about eight on the median line. Hemelytra coarsely pubescent; veins on clavus strongly raised; apical cells transversely compressed, third cell triangular, not reaching beyond angle of posterior marginal vein. Legs stout; spurs and spines strong; femur and tibia with dark lateral lines coalescing with two dark spots on outside of tibia.

Sub. sp. I. *lineata*. Pronotum yellow, with five black bands.

Var. *a*. Clavus with veins and margin yellow inclosing dark areas.

b. Clavus entirely fuscous.

Sub. sp. II. *binotata*. Pronotum entirely black.

Habitat: Utah (Uhl), Cal. Col. and Ariz.

This species is so widely variable that with only the extreme forms there would be no hesitancy in pronouncing them separate species, but with a large amount of material a series can be found which clearly establishes their relationship. Uhler's description is an absolutely perfect one for Sub. sp. *lineata* var.

a, but would apply only slightly to var. *b*, and would absolutely exclude Sub. sp. *binotata*.

C. binotata was a ms. name given to that var. by Uhler, I believe, and under which name specimens have been distributed in collections.

C. PROTEUS, FITCH.

C. saint cyri. Prov.

The original description was published in the fourth annual report of the New York State Museum (1851). Republished in the ninth report of the State Entomologist of New York, page 394, from which the following description and sub-divisions are copied:

> Head bright yellow, a black band on anterior margin of vertex and a broader one on the front; front polished, without transverse striæ; a callous black dot near the apex of the elytra; legs yellowish-white, tarsi black. Length, 0.16; males slightly smaller.
>
> Closely allied to the *C. atra* of Germ., but on examining a host of specimens not one occurs in which the legs are annulated with black or fuscous.

He then divides the species up into sub-species and varieties as follows:

- Sub. sp. I. *flavicollis*. Thorax entirely yellow.
  - Var. *a*. Elytra yellow.
  - *b*. Elytra with an oblique blackish vitta.
- Sub. sp. II. *cincticollis*. Thorax with a black band.
  - Var. *a*. An interrupted black band on the anterior margin of the thorax.
  - *b*. An entire black band on anterior margin of the thorax.
  - *c*. Thoracic band crossing the disk instead of the anterior margin.
  - *d*. Band on the disk of the thorax, and scutel black.
- Sub. sp. III. *maculicollis*. Thorax with one or two discoidal spots.
  - Var. *a*. A black spot on disk and an interrupted band anteriorly.
  - *b*. A black spot on the disk and anterior band entire.
  - *c*. Two black spots on the disk of the thorax.
- Sub. sp. IV. *nigricollis*. Thorax black, with a yellow band forward of the disk.
  - Var. *a*. The black band on the anterior margin of the thorax interrupted.
  - *b*. The band continuous.
  - *c*. Scutel black, with a yellow dot at its base.
  - *d*. Scutel entirely black.

Fitch's "host" of specimens were probably all from one locality and may all have belonged to one sub. sp., according to my classification below. At any rate I have at hand four specimens, that are all clearly and unquestionably varieties of my sub. sp. *vittata*, each one of which answers the requirements of a different sub. sp. of Fitch; on the other hand I have specimens which are unquestionably of different sub. sp., and occurring in widely separated localities which would be placed in the same sub. sp., and the same variety by Fitch's classification, clearly showing that the color of the pronotum is not of sufficient value on which to base sub-species. He made no provision for the black varieties and from his remark about the relationship of *C atra*, Germ., it is highly probable that he had none.

A careful study of about seventy-five specimens, embracing representatives from widely separated areas resulted in the adoption of the color marking of the clavus as a character constant for a given sub-species, and in the determination of specific characters as follows:

Size, medium; front strongly inflated, upper half black, lower half yellow; legs bright yellow, with lateral black lines.

Front rising abruptly from face at sides continuing in same plane as vertex above; upper half black; lower half, loræ and clypeus yellow, a black dot on center of clypeus. Vertex slightly, transversely depressed, anterior margin not distinctly carinated; suture between front and vertex indistinct. Pronotum bare, broadly, indistinctly, transversely wrinkled, wrinkles minutely striated, about twelve on the median line. Hemelytra with a fine short pubescence; first discoid cell wider than second second apical cell broad, nearly equal to third. Abdomen black or fuscous; legs bright yellow; a lateral line on front of femur, one on each side of tibia; all three joints of tarsi, and last segment of rostrum black. Length, four mm., width of pronotum about one and one-half mm.

Habitat: Iowa. Illinois (Forbes). Quebec, Canada, Ontario, Canada, New Hampshire, Massachusetts. Pennsylvania, New York, District of Columbia, New Jersey (Smith), West Virginia.

Sub. sp. I. *flava*. Anterior two-thirds of clavus yellow.
  Var. *a*. Scutellum with a yellow spot
    b. Scutellum black.
Sub. sp. II. *vittata*. Clavus yellow with an oblique black vitta through the middle.
  Var. *a*. Pronotum with one yellow band anteriorly.
    b. Pronotum with two yellow bands.
    c. Pronotum entirely yellow.

Habitat: New York, Pennsylvania, Massachusetts. Connecticut, District of Columbia.

Sub. sp. III. *nigra*. Clavus entirely black.
  Var. *a*. A yellow band on vertex, and one on face next to vertex.
    b. Yellow bands wanting; entirely black above; legs darker.

Habitat: West Virginia, Pennsylvania, District of Columbia. Massachusetts, New York.

Specimens of *C. saint cyri* Prov., that I have from Quebec, Canada, belong to sub. sp. I. *flava*.

C. XANTHOCEPHALA GERM.

Germar's original description (Germ. Zeit. fur die Ento., 1-189) is as follows:

Nigra, capite flavescente, frontis, fascia nigra, elytris maculis marginatibus hyalinis, puncta colloso ante apicum nigro, pedibus pallido-fuscaque annulatis.

Habitat in Pennsylvania, Carolina, Zimmermann. One and one-half lin lang. Kopf gelb, um der scheitel dunkel, eine queerbinde auf der unterseite schwarz. Deckschilde schwarz, ein Fleck am vorderrande vor der Spitze, ein anderer, der den ganzen Hinterrand einnimmt, glashell, latzterer mit einem schwarzen schwieligen Punkte vor der Vorderecke. Beine gelblich, braun geringelt.

This species is the most constant in size and coloration of any in the genus. From a study of over one hundred specimens representing every locality mentioned below, I have prepared the following description:

Small, brown or black without markings of any kind above; face with brown bands above, dark below with a distinct light band crossing the center; hemelytra very sparsely pubescent.

Front moderately inflated, light above with about nine transverse interrupted brown bands, band below these, and clypeus black, lorae, included portions of front, and margin of anterior coxal fossæ yellow. Vertex not strongly depressed; suture between vertex and front distinct. Pronotum with about nineteen fine indistinct wrinkles. Hemelytra strongly impunctured, very sparsely pubescent; second apical cell broad, irregularly wedge-shaped. Under side black; legs brown, spurs and spines tipped with black. Length, three and one-half mm., width of pronotum, one and four-tenths mm.

Var. *a*. Black above; a small white spot on center of costa.
b. Glaucus above.

Habitat: Mississippi, Arkansas, Texas, Louisana, Maryland, District of Columbia, Virginia, Florida, Iowa, Pennsylvania, Carolina (Walker) and New Jersey (Smith).

C. OBTUSA, SAY.

Cercopis obtusa Say. Jour. Acad. Nat. Sci., Phila., IV, 339. (1825.)
Clastoptera achatina Germ. Zeit fur die Ent., I, 189. (1839.)
C. testacea Fitch. Fourth An. Rep. N. Y. State Mus. (1851.)
C. pini Fitch. Fourth An. Rep. N. Y. State Mus. (1851.)
C. lineatocollis Stal. Eng. Resa Omk. jord., IV, 286.
C. osborni Gillette. Hemip. Col., 71. (1895.)
C. stolida Uhl. ?
C. undulata Uhl. ?

Say's original description (Coll. Writings. Vol. II, page 256) is as follows:

> Head and anterior part of thorax pale, with three transverse lines; wings varied with brown and pale; body short, oval; head pale yellowish, an elevated, reddish-brown, transverse line between the eyes and before the stemmata; front with about nine parallel, equidistant, reddish-brown lines, which are interrupted in the middle and abbreviated in the cavity of the antennæ; antennæ placed in a deep cavity, beyond which the seta only projects, head beneath black; thorax pale yellowish before, reddish-brown and rugose with continuous lines behind, anterior edge elevated, reddish-brown, a reddish-brown transverse band on the middle; scutel pale reddish-brown; hemelytra varied with fucous and pale, generally forming a band on the middle which is more distinct on the costal margin, spot at tip and larger one at base; nervules dark-brown; feet black, joint whitish; tibiæ and tarsi whitish, posterior tibia bi-spinous behind, of which one is very robust; length rather more than one-fifth of an inch.
>
> The band of the hemelytra is sometimes indistinct, three brown dots near tip; female generally paler, with the abdomen whitish.

This species presents a remarkable number of quite distinct sub-species and varieties, and, owing to the fact that Say's description was of an extreme variety, a great deal of confusion has existed as to its limits, resulting in quite a number of these varieties being described as distinct species. I have appended these descriptions and have retained their names for the sub-species, except *testacea* and *pini*, which I find to be simply varieties of a sub-species of which the description of *osborni* is more nearly true; and it is therefore retained in preference.

The following synopsis of the species is a result of a summary of the different descriptions, and the study of 200 specimens representing every state given below with the exception of New Jersey. I am reasonably confident that with the possible addition of a few more varieties, it will stand the test of any farther discovery of material:

Large; front broad, flattish, with about nine bands above; second apical cell rectangular, elongate; pronotum finely, sharply wrinkled.

Front rising gradually from face at sides, making an obtuse angle with vertex above, upper portion light with about nine parallel, equidistant, transverse, interrupted, brown bands. Vertex very strongly, transversely depressed, carinated anterior margin prominent; suture between vertex and front distinct; ocelli situated near front margin.

Pronotum with about nineteen minute distinct wrinkles. Hemelytra minutely punctured, with a fine thickly set pubescence; second apical cell rectangular, elongate. First, discoid cell curved, narrower than second. Legs stout; spurs, spines and third tarsal segment tipped with black.

Length, four and one-half mm., width of pronotum, two mm.

Sub. sp. I. *obtusa*. Lower half of face fuscous or black.

Var. *a*. Dark; a distinct oblique, light band on hemelytra; pronotum, anterior half, light yellow, divided by a transverse brown band.

Habitat: Iowa, New Hampshire, Massachusetts, New York, Maryland, District of Columbia, West Virginia, Ontario, Canada.

Var. *b*. Light; same markings as above, only much lighter and less distinct.

Habitat: Iowa, New York, District of Columbia.

Var. *c*. Dark; hemelytra coppery; thorax without band; pronotum yellowish (*achatina*).

Habitat: Pennsylvania.

Sub. sp. II. *lineatocollis*. Lower half of face dark with a light band crossing the middle.

Var. *a*. Pronotum entirely dark; scutellum yellow; legs light with lateral dark lines. California.

b. Pronotum, posterior half dark, anterior half sulphur yellow; lines on femur and tibia broad, almost confluent. Colorado.

c. Pronotum light yellow, narrow brown band anteriorly; legs light, lateral line faint; dark band on clypeus reduced to a dot; hemelytra pale rufous, nervules brown, very distinct West Virginia, District of Columbia.

d. Pronotum entirely sulphur yellow; hemelytra dark coppery; legs brown. Maryland, District of Columbia.

Sub sp. III. *osborni*. Face entirely light, bands on front obscure.

Var. *a*. Light olive green; scutellum sulphur yellow. Colorado, Wisconsin, West Virginia, District of Columbia.

b. Copper colored throughout (*testacea*). New York, West Virginia, District of Columbia, New Jersey.

c. Black; posterior margin of vertex, anterior margin of pronotum, costal margin of hemelytra, and legs yellow. (*Pini*) North Carolina, District of Columbia, New York (Fitch).

The following original descriptions may assist in recognizing the corresponding sub. sp. and varieties. Var. *a*, under each sub. sp., being its type, and of course the only one to which the description will entirely apply.

C. achatina.—(Germ. Zeit. fur Ento. Vol. I., 167.) Testacea, fronte nigra, elytris ante apicem fuscis, macula submarginali ante apicem nigra, femoribus medio fuscis. Hab. in Pennsylvania, Zimmermann. Two bis 2¼ lin. lang, rothgelb oder grau gelb, stirn und Mittlebrust, bisweilen auch der Hinter-theil des Bauches schwarz. Deckschilde von der mitte weg bis vor die Spitze Schwarzlichbraun, doch bleibt ein Fleck am Seitenrande hell. Die Ader des vorderrandes fuhrt vor ihrer Spitze einen schwarzen Fleck.

C. lineatocollis. Stal. (Eng. Resa, Omk. jord. IV, 286.) Caput dilute flavescens, verticis marginibus basali et apicali lineisque transversis frontis apicem versus longitrorsum impressæ nigrofuscis. Thorax postice profunde angulatosinuatus, medio longitrorsum carinatus dilute flavescens, lineis pluribus tranversis fuscis ornatum. Tegmina latitudine vix duplo longiora, sordide flavescente-pellucida, medio fascia antrorsum augustata et abbreviata albida, anterius a linea, posticea fascia indistincta fuscis terminata, callo rotundato fere apicali ad marginem costalem nervisque apicalibus hic illic fuscis. Subtus nigro-varia. Pedis dilute flavescentes, vitta femorum maculisque tibiarum nigro-fuscis.

C. osborni Gillette. (List Hem. Col. p 71) Female: face two-thirds wider than long, minutely, indistinctly sculptured; clypeus broad at base, gradually tapering to the pointed apex, one-fifth longer than broad, basal suture obsolete; loræ long, nearly as long and half as broad as clypeus; genæ narrow, outer margin concave beneath eyes, convex below loræ where they are very narrow, touching the clypeus at the broadest part; front but little longer than broad, superiorly very broadly and evenly rounded. Vertex very slightly transversely depressed, anterior margin carinately elevated, not longer at middle than at eyes. Pronotum transversely wrinkled, minutely scabrous, two distinct pits behind anterior margin near the median line, three-fourths wider than long, anterior curvature three-eighths of length. Scutellum finely and transversely wrinkled and minutely scabrous, longer than head and pronotum, twice longer than wide. Elytra with a fine, thickly set, golden pubescence, entirely finely, densely punctured. Color pale rufous throughout, tinged with olive green on pronotum and clavus, beneath more yellowish. Length, five and one-half mm. Described from two females. Large but somewhat narrower across the hemelytra than is usual in this genus.

C. testacea Fitch. (Ninth Rep. St. Ento. N. Y., 393.) Testaceous; scutel rufous; elytra with a polished callous-like black dot near the apex. Length, 0.20 inches.

C. pini Fitch. (Ninth Rep. St. Ento. N. Y., 393.) Black; head yellow, with a black band on the anterior margin of the vertex; thorax with a yellow band anteriorly; elytra with a broad hyaline under margin interrupted in the middle and a black callous dot near the apex. Length 0.14.

NOTE—I have been unable to obtain specimens of *C. undulata* and *C. stolida* of Uhler from the West Indies, but from their descriptions I am very confident that they will be found to be varieties of *obtusa* also. So that, with the possible exception of *C. brevis*, Walker, this paper includes all the present known or described forms of the North American Clastoptera.

GEOGRAPHICAL DISTRIBUTION.

Quite a number of interesting facts have been brought to light through a comparative study of geographical distribution. Each species possesses a wide range, while some of the varieties are exceedingly sectional in their distribution. As a whole *obtusa* has the greater range, occurring from Massachusetts to California, and from Canada to Georgia, and probably to the West Indies. Sub-sp. I, *obtusa* is the most common form in the east and the only one found in the Mississippi valley, while of sub-sp. II, *lineatocollis*, var. *a* and *b* occur only in California, Arizona and Colorado, and var. *c* and *d* have only been reported from Maryland and West Virginia. Sub-sp. III *osborni*, var. *a*, has a wide range, while var. *b* (*testacea*) and *c* (*pini*) are only found on the eastern coast from New York to North Carolina.

C. proteus, sub-sp. I, *flava*, is found throughout the northern half of the Mississippi valley and the eastern states up to Canada, while sub sp. II and III, *vittata* and *nigra*, are found only in Pennsylvania and the surrounding states. Both varieties of *xanthocephala* have the same wide range: the southern part of the United States, from Maryland to Iowa on the north to Florida and Texas on the south. *C. delicata* with all of its varieties ranges from Colorado to California, and from Utah to Arizona.

ECONOMIC IMPORTANCE.

As a whole they are of considerable economic importance. Although not usually occurring in sufficient numbers to be noticeably injurious, however, *proteus* has been reported as having done considerable damage to cranberry swamps in a number of instances. Their food habits have not been very accurately determined. In general they feed on the sap of trees and shrubs, occurring most abundantly in low places. They have been reported as occurring on the ash, oak, pine, alder, butternut, elder, blueberry, cranberry and some of the larger grasses and weeds.

SUMMARY.

The study of this genus just recorded only adds one more instance to the many giving evidence against the immutability of species. Here we have four species, of which the larger and lighter varieties are widely separated, and easily recognizable by constant and strikingly distinct color markings, while at the other end of the series are small dark forms only capable of separation and recognition by reference to structural characters rendered indistinct by deep coloration. To still more complicate matters, *proteus* excepted, they have intermediate light green or glaucus forms which so grade into each other in size and shade that it is only on structural characters in general, and the shape of the apical cells, in particular, that they can be separated.

The structural characters upon which the species have been founded have proved so constant, within measurable variations, for all the different varieties, that I am confident the species and the synonymical determinations will stand. The limitation of sub-species and varieties, while as accurate and complete as the 400 specimens of available material would allow, will doubtless undergo some expansion and correction with the accumulation of new and larger collections of material.

In conclusion I wish to acknowledge indebtedness to Messrs. Gillette, Lintner, Ashmead, Weed, Fernald, Goding, Skinner, Van Duzee, Sirrine, Mally and Gossard and Miss Beach for the privilege of examining material, and for other favors extended, and to Professor Osborn, in particular, for the use of his private collection and the department material, and for his invaluable counsel and advice.*

EXPLANATION OF PLATES.

PLATE XI.

Figure 1. *Clastoptera obtusa*, Say.

Color markings of Sub-species I. *obtusa.*

Showing color markings of faces.

Figure 2. *C. obtusa-obtusa.*

Figure 3. *C. obtusa-osborni.*

Figure 4. *C. obtusa-lineatocollis.*

Figure 5. *C. proteus-nigra* (variety *b.*).

Figure 6. *C. proteus* Fitch.

Figure 7. *C. xanthocephala* Germ.

Figure 8. *C. delicata-lineata* (variety *a.*).

PLATE XII.

Venation of upper and under wings represented by one species from each genus as a type. The venation seems to be very constant within generic limits, as far as I have had opportunity to examine, with the exception of *Philænus* which either possesses two types or else there is another as yet unrecognized genus represented in our fauna.

Figure I. Wings of *Monecphora bicincta*, Say.

Figure II. Wings of *Philænus* sp.

Figure III. *Lepyronia 4–angularis* Say.

Figure IV. *Aphrophora quadrinotata*, Say.

Figure V. *Philænus* sp.

Figure VI. *Clastoptera obtusa*, Say.

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* This work has been done in the entomological laboratory of the Iowa Agricultural College, and submitted as a graduating thesis.

PLATE XIII.

Figure 1. Leg of *Aphrophora quadrinotata*, Say, showing double row of spines.
Figure 2. Leg of *Lepyronia quadrangularis*, Say.
Figure 3. Leg of *Clastoptera proteus*, Fitch, showing single row of spines.
Figure 4. Side view of *C. delicata*, Uhl., showing outline of face.
Oblique dorsal view of same showing inflation of front.
Figure 5. *C. proteus*, Fitch, same as above.
Figure 6. *C. xanthocephala*, Germ.
Figure 7. *C. obtusa*, Say.
Figure 8. Venation of hemelytra, *C. delicata*.
Figure 9. Same for *C. proteus*.
Figure 10. Same for *C. xanthocephala*, Germ.
Figure 11. *Clastoptera obtusa*, Fitch.
1, 2 and 3; first, second and third apical cells, a and b; first and second discoid cells.

PLATE XIV.

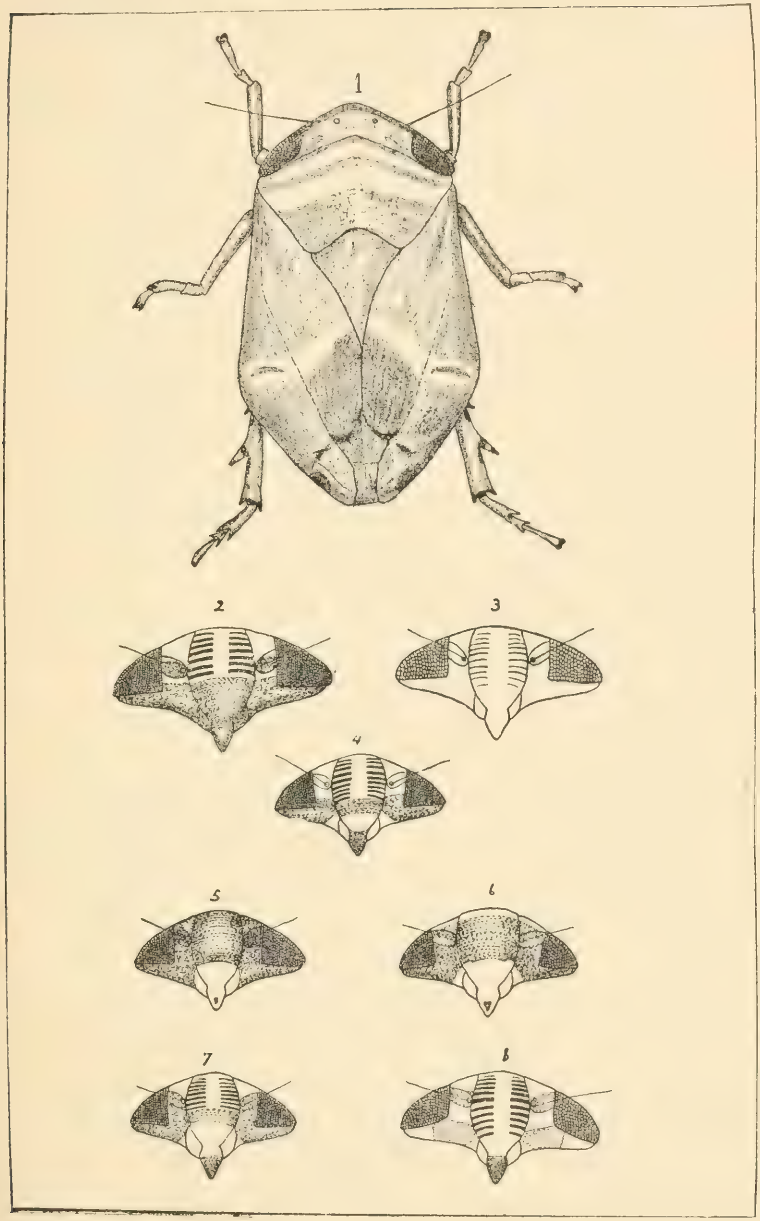
Figure 1. Abdomen of *Lepyronia quarangularis* Say, male, ventral view.
Figure 2. Female, of same.
Figure 3. Male, dorsal view.
Figure 4. Abdomen of *Aphrophora parallela*, Say, male, ventral view.
Figure 5. Female, ventral view.
Figure 6. Same, dorsal view.
Figure 7. Abdomen of *C. obtusa*, male, posterior view.
Figure 8. Female, same view.
Figure 9. Abdomen of *C. xanthocephala*, Germ., male, posterior view.
Figure 10. Female, same view.

OBSERVATIONS ON THE CICADIDÆ OF IOWA.

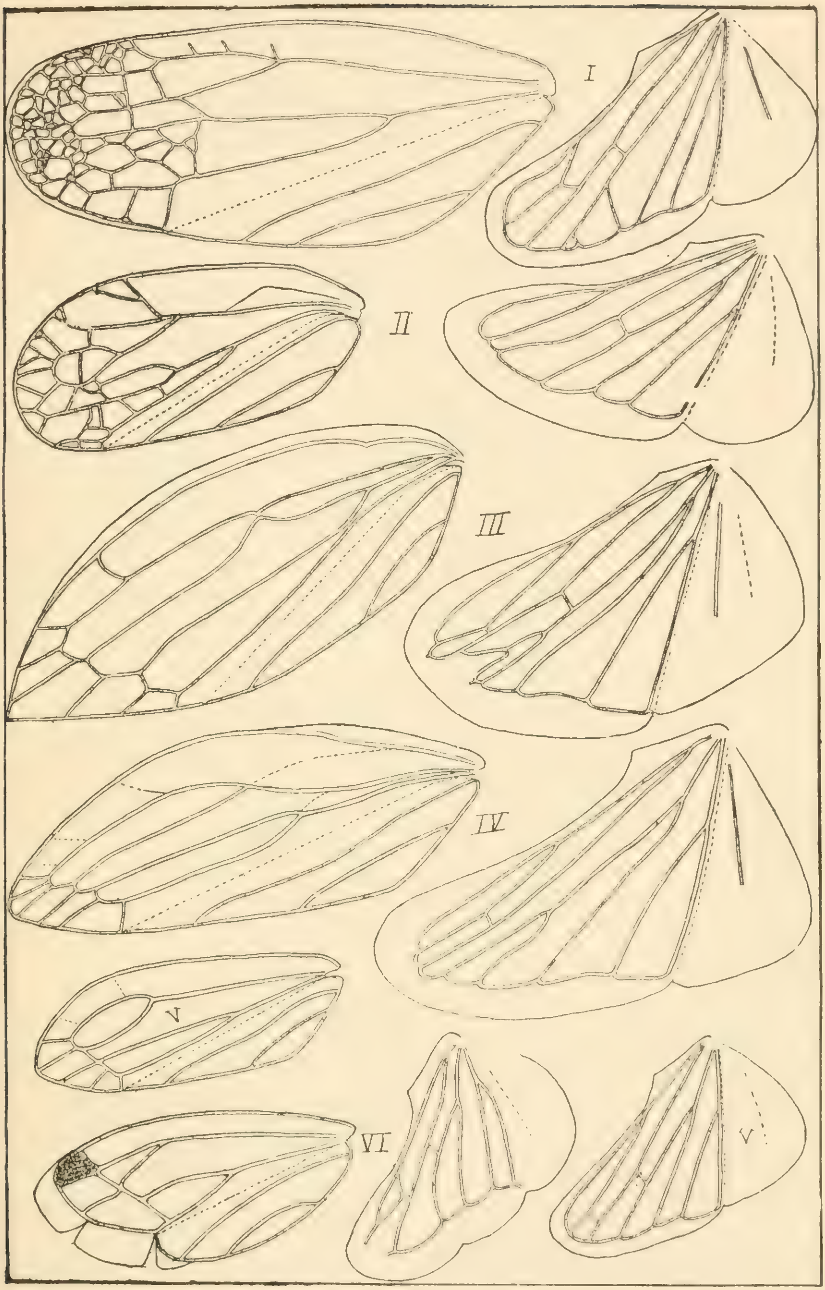
HERBERT OSBORN.

The members of this interesting group of insects, which contains the largest of our native Homoptera, have at least four representatives in the state of Iowa and it is the intention to call attention to these in this paper and also to put on record some observations regarding their habits and distribution which may serve as a basis for further investigations concerning them.

Cicada dorsata Say. One specimen of this large species in the collection of the Iowa Agricultural College from a student who stated that it was taken in Poweshiek county, is the only example indicating its occurrence in the state.



E. D. Ball, del.



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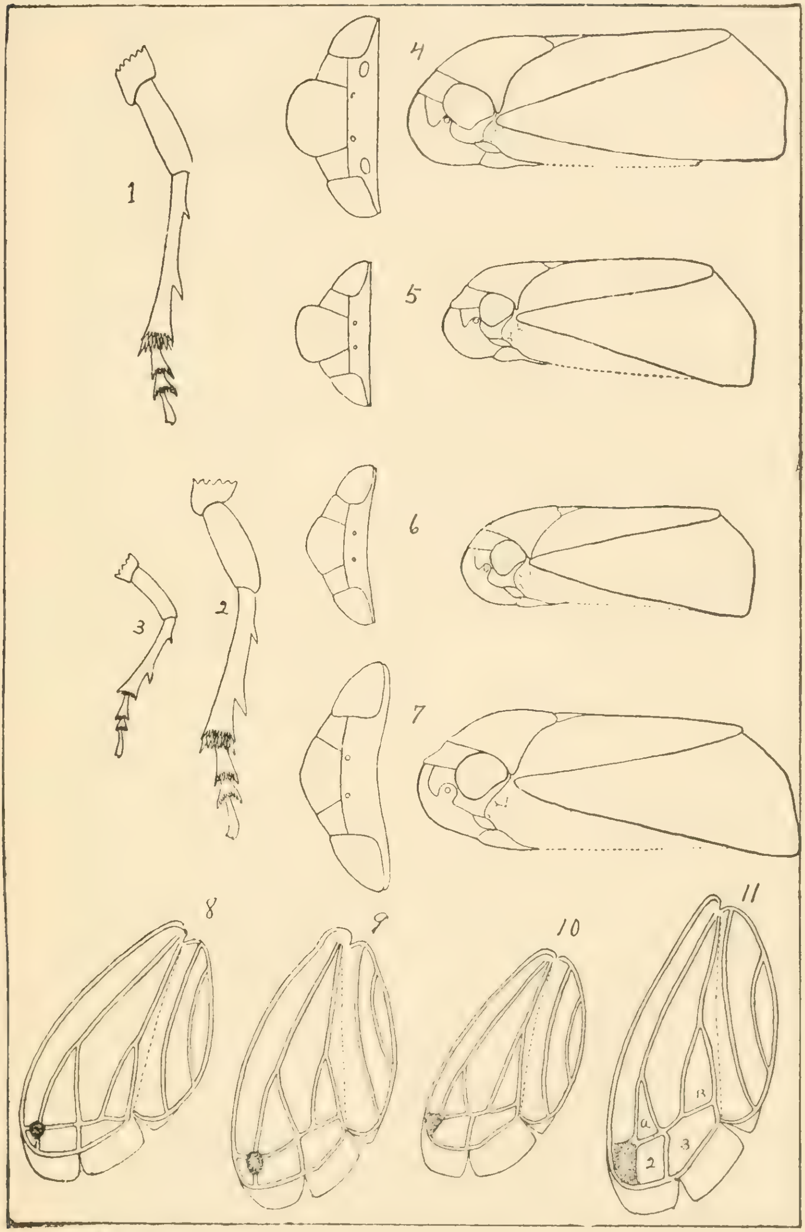
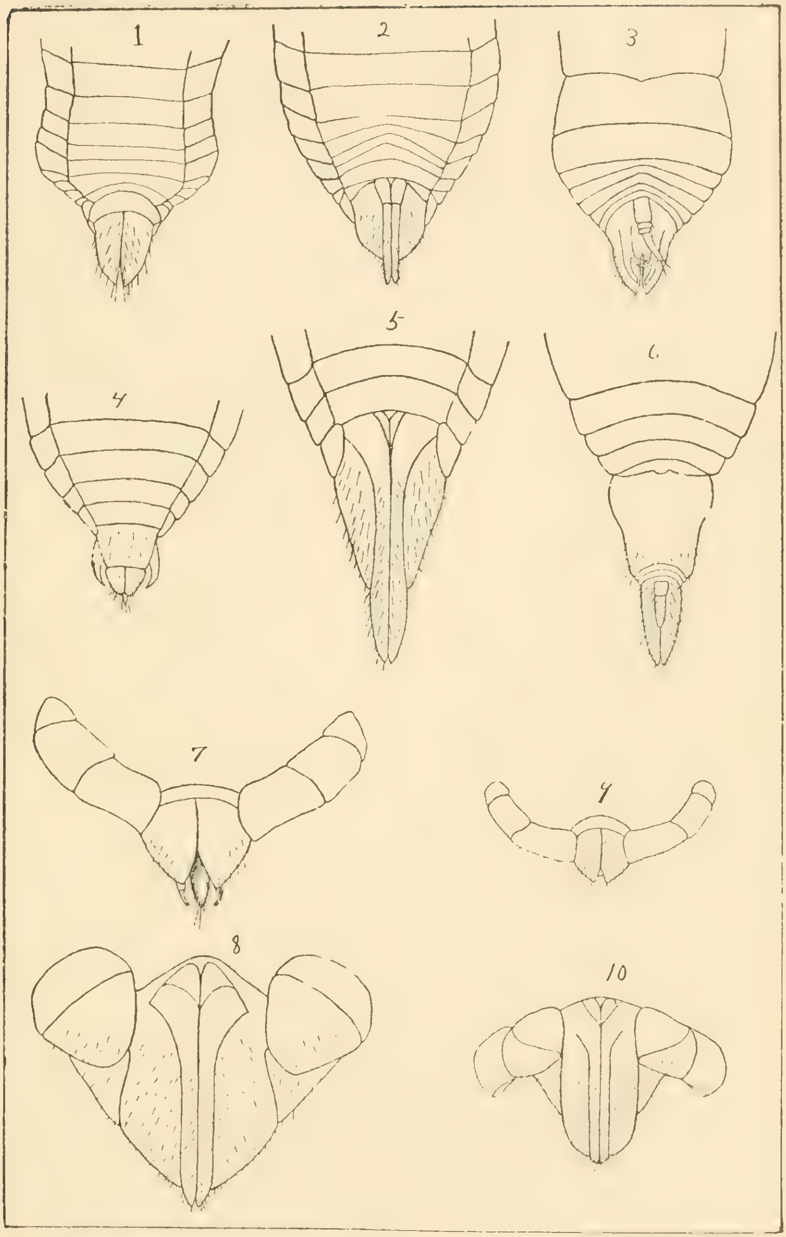


E. D. Ball, del.

PLATE XIV.



E. D. Ball, del.

THE DOG-DAY CICADA.

(*Cicada tibicen* Linn.)

This is our larger common species, and one which, by its penetrating note, renders itself a conspicuous feature of the autumn weeks. First described by Linnè it has since received various appellations *opercularis*, Olivier; *pruinosa*, Say; *lyricen*, DeGeer and *canicularis*, Harris. This synomony arises partly on account of the variability of the species. This variation is considerable when its range over a large part of the United States is considered, but within our own state this variation is somewhat limited. Specimens collected here generally conform closely to the description given by Say for his *pruinosa*.

Its distribution is quite general and I assume that it occurs throughout the eastern part of the state, at least, and in general over the timbered portions. I am assured by good observers, however, that there are places in the northwest part of the state where it is unknown. Specimens have been collected or received from many widely different localities.

In spite of its abundance and wide distribution our knowledge of its habits and life-history is very meager, though it is stated to require two years to complete its growth and to deposit its eggs in apple trees as one at least of the plants it may injure.

THE PERIODICAL CICADA OR "SEVENTEEN-YEAR LOCUST."

(*Cicada septen-decem* Linn.)

The "seventeen-year cicada" is doubtless the most interesting of all the Cicadas on account of its phenomenally long larval life. As is well known it lays its eggs in twigs of various trees and the larvæ entering the ground feed upon the roots of plants, and require a period of seventeen years to complete their growth. Two broods are represented in the state.

Brood V, Distribution.—In 1888, the locust year for the eastern part of the state, I secured, through the state crop service, reports from many of the localities which gave decidedly useful information with reference to limitations of the brood and comparison with previous occurrences. Records were received from over thirty counties and about ninety correspondents.

The limits of this brood have been outlined heretofore by Mr. Suel Foster, Dr. William LeBaron and Prof. C E. Bessey.

Dr. LeBaron (2d Rept. Ill. Insects p. 130) writes as follows: "In the Prairie Farmer for July 29th, a brief outline of the locust range was published by Mr. Suel Foster, of Muscatine, Iowa, but in this outline, as Mr. Foster himself stated, many gaps were left undetermined. I have found Mr. Foster's outline to be, in the main, correct, and have filled, as far as possible, the gaps which he left. I will take the same starting point with Mr. Foster, namely, the junction of the Iowa River with the Mississippi in Louisa county, Iowa. Thence, in a northwesterly direction, following the eastern branch known as the Cedar River as far north as about opposite the mouth of the Wisconsin river. Thence east in about the same line of latitude to Lake Michigan, following the Wisconsin river so far as it lies in this line, thus leaving out the northernmost counties of Iowa and the two lower tiers of counties of Wisconsin." The rest of the description refers only to territory outside of Iowa.

In 1878 at the time of the occurrence of Brood XIII in southern Iowa, Prof. C. E. Bessey, then of the Iowa Agricultural College, collected data for the determination of the boundaries of that brood and incidentally collected considerable information concerning the distribution of Brood V in the eastern part of the state.

His report upon this investigation appeared in the American Entomologist, Vol. I. N. S., p. 27. As there given the area included is considerably greater than that outlined by Dr. LeBaron. He does not seem to have noticed the record of LeBaron given above. His outline is as follows:

Starting at nearly the same point in Wapello, Louisa county, the line he draws extends more to the westward, including the western or Iowa branch of the Iowa river as far west as into Tama county, and considerable territory to the southward, including all of Johnson, more than half of Iowa and a portion of Poweshiek counties. From Tama county northeastward to the extreme northeast corner of the state including nearly all of Black Hawk, Fayette and Allamakee counties, and part of Bremer, Chickasaw and Winneshiek, with a possible extension westward so as to include all the counties to the north and east of Tama, though reference to his notes indicates some of the counties included, as Allamakee, Winneshiek, Black Hawk, Fayette and Bremer to be doubtful.

The counties reporting Cicadas for 1888 are as follows: Benton, Black Hawk, Buchanan, Clayton, Clinton, Cedar, Delaware, Dubuque, Iowa, Jackson, Johnson, Jones, Louisa, Muscatine, Scott, Tama. This shows only the counties reporting but does not indicate the extent or distribution in the counties, and this, for the border counties particularly, is quite important in fixing a definite boundary. I took pains therefore to locate the particular township from which the reports came, which was possible by examining the records at the secretary's office in Des Moines, and was thus able to locate the actual boundary usually within six miles at most, certainly within the limits of the ordinary flight of the insect.

The line of townships beginning at the Mississippi river in Muscatine county and naming those on the border line from which positive reports were received is as follows: Muscatine county, Fruitland, Cedar; Louisa county, Columbus City; Iowa county, York, Summer; Benton county, Saint Clair; Tama county, Clark, Geneseo; Black Hawk county, Spiny Creek; Buchanan county, Sumner; Clayton county, Cox Creek, Clayton.

For convenience sake we may carry our line through the towns and villages nearest this line and it will be approximately as follows: Fruitland, along south line of Muscatine to Columbus City, then along the west of the Iowa river till in Johnson county, then northwest to York Center, Iowa county and to near Ladora, then northeast to Blairstown, then northwest to Dysart, then northeast through Laporte City, Independence, Strawberry Point, Elkader and Clayton.

The area of natural timber corresponding for the most part with the valleys of the rivers and smaller streams, the distribution of Cicada may be pretty accurately expressed by defining them, and on this basis they may be said to occur in the valley of the Iowa river from Columbus City to west of Marengo, in the valley of the Cedar river and its tributaries as far to the northwest as Laporte City. In the Wapsipinicon to Independence, in the Maquoketa to Strawberry Point, in the Turkey to Elkader, and north on the Mississippi from south central Muscatine county nearly to McGregor.

Numerous reports not specially indicated, attest their abundance in all the central counties of this area and need not be specified but some which bear particularly upon the border line may be quoted here.

Mr. V. C. Gambell, a student in entomology whose home was at Winfield, in Henry county, saw no locusts there but a man in that vicinity reported hearing them and had seen one shell. This is rather uncertain testimony especially in view of absence of reports from this and the adjoining county to the north. If correct it shows a very feeble representation of the insect there. Mr. Gambell noticed in traveling on the Chicago, Rock Island & Pacific railroad from Brooklyn to Iowa City that the trees were injured, apparently by Cicada. If all due to Cicada this would carry the brood into Poweshiek county several miles further west than indicated by other reports.

Mr. E. N. Eaton of Keota, in the extreme east of Keokuk found no locusts and no reports of them for that county.

Mr. P. H. Rolfs reports for the central eastern border of Tama county that there were no locusts and none for about five miles to the east of the county line, while Mr. F. A. Sirrine reports for a point about six miles further north that locusts were in Tama county, two miles west of the county line in Geneseo and Clark townships, but not in townships west so far as he could learn.

The following additional statements from correspondents have a special significance in determining the border line:

Louisa county, Wapello township, "None; a few in north part of the county." Columbus City, "Locusts present." In Keokuk county, Clear Creek township, "None here this year, but here seventeen years ago." Prairie township, "None yet: were here seventeen years ago." Garman township, "No locusts, last in 1877" [1878 Brood XIII probably]. Iowa county, York township, "Locusts in limited numbers in northeast third of this township." Poweshiek county, Malcom township, "None." Sheridan township, "None." Bear Creek township, "None. None seventeen years ago." Warren, "None yet, July 15th. Were here sixteen and seventeen years ago; second year in great numbers and did great damage to fruit trees and shrubbery." Chester township, "No seventeen year locusts to amount to anything; appeared in 1861 and 1878." [Brood XIII]. Black Hawk county, Spring Creek township, "Yes, and seventeen years ago." East Waterloo township, one correspondent says: "No, never here." Another says: "No. A few seventeen years ago." Fayette county, Westfield township, "None;

none seventeen years ago." Eden township, "None." Jefferson township, "None within thirty-four years to my knowledge." Clayton county, Giard township, "None this year; a few seventeen years ago."

Brood XIII.—Professor Riley (1st Ann. Rept. State Entomologist of Mo.) mentions this brood as occurring along the southern border of Iowa, but does not specially define its limits. The 1878 occurrence was studied by Professor Bessey and the data collected enabled him to define the limits of the brood with considerable exactness (Amer. Entom., N. S. Vol. I, p. 27).

According to this record they occurred in the following counties: Van Buren, Davis, Wayne, Decatur, Des Moines, Henry, Jefferson, Wapello, Monroe, Union, Louisa, Keokuk, Mahaska, Marion, Warren, Madison, Adair, Cass, Iowa, Poweshiek, Jasper, Polk, Dallas, Marshall, Story, Boone, Greene, Hamilton, and they were assumed to occur in the counties embraced within the area encompassed by these, Clarke, Appanoose, Ringgold, Washington, Johnson, as indicated on his map, outline of which is shown. (Plate XV.)

On the recurrence of this brood last season (1895) I published requests in a number of state papers and also obtained from students and others, data covering as much territory as possible. The responses to the published requests were not so general as could be wished. In some cases many reports coming from the same locality, while a number of counties, where they must have occurred, furnished no reports.

Taking the counties reported in their order from the eastern border of the state they run as follows: Louisa, Keokuk, Poweshiek, Tama, Marshall, Story, Webster, Boone, Dallas, Madison, Union, Decatur, and for counties within the outer limits, Polk, Jasper, Marion, Monroe, Wapello, Jefferson, Van Buren, Lee.

The counties within this area which must, in all probability, have been visited, are Warren, Mahaska, Lucas, Wayne, Appanoose, Davis, Washington, Henry, Des Moines, while the doubtful ones are Johnson, Iowa, Hamilton, Greene, Guthrie, Adair, Ringgold.

Reports from Iowa and Johnson are quite positive as to their non-appearance in those counties, though it is possible our informants could speak for only a part of the area. There is also a probability that they occurred in Hamilton county, close to the Des Moines valley at least, if not in the Skunk.

In Greene, Guthrie and Adair they may have occurred in the valley of the Raccoon or tributaries.

By river valleys, then, which give really the more important distribution, we can say that they appeared in the Iowa valley at Louisa county, were absent or possibly scarce in Johnson and Iowa counties, but present in Tama and Marshall and north as far as Marshalltown; in the valley of the Skunk river from its mouth to Ames in Story county; in the valley of the Des Moines and its tributaries as far north as to near Fort Dodge and Lehigh, and in the Raccoon in Dallas county; also in the valley of the Grand river and its tributaries in Decatur, Union and Clarke counties.

Comparison of the points giving actual occurrence in 1895, represented on our map by square black spots, with the outline of Professor Bessey's map shows a reduction in most of the outline, with a slight extension in the Des Moines valley. These reports on the whole would suggest a reduction of the area, and many of the reports state a reduction in number of cicadas as compared with previous occurrences.

It is of course impossible with the records for even three or four occurrences to draw any conclusions as to the future history of the insect or assign causes to any apparent changes, still some suggestions as to probable influences may not be out of place as indicating lines of future observation and record. It is evident that many years must elapse before the problems connected with the species can be properly discussed.

Admitting that the broods in these respective areas have declined, it is interesting to inquire into the possible conditions affecting the perpetuation of the species.

It should be borne in mind that the great bulk of settlement in these parts of the state occurred between the appearance of the broods in 1854 1871 and 1861–1878 respectively, and that the settlement resulted in some important changes of the timber distribution. These changes took two forms, first a diminution of the natural timber belts along the streams from the necessities for fuel and in much less degree the clearing of limited tracts for cultivation. Second, an extension of the timbered area by the planting of groves, wind-breaks, orchards, etc., on the treeless portions. The former I believe not to have affected the area or quantity of timber very greatly, as it would be made good by the natural growth and extension and, especially as regards the Cicada, had, I believe very little influence. The latter, though perhaps having very little effect as increasing the actual quantity of timber, seems to me a much more important factor in connection with the Cicada problem. These insects show a very decided tendency to deposit their eggs in young trees, and in 1871 and 1878 found abundant opportunity in the numerous young orchards and groves developed since their prior occurrence to satisfy this propensity, so much so that they must have in many places deserted in no small degree the natural timber areas for these artificial ones.

Now, it seems natural to suppose that depending normally for their food on roots common to areas of natural timber they should have been met with a deficiency of such food in many of the localities to which the adults had flown to deposit eggs, and consequently have failed to develop and mature.

Such an influence will, of course, not be permanent and if this be the only factor of importance Cicada should recuperate in the future.

It has been my privilege to observe personally the occurrences of both these broods since 1871, and I hope to have the opportunity to observe many of their generations in the future.

TIBICEN RIMOSA, SAY.

This species, which may be considered as belonging more particularly to the northern and western fauna, is represented in this state by a depauperate form and in the northern and western portions by a form more closely approaching the western type.

It was described by Thomas Say in Proc. Acad. Nat. Sci. for 1830, p. 235, who ascribes it to the Missouri and Arkansas and says further "Mr. Nuttall presented me with two specimens which he obtained on the Missouri, and I found one on the Arkansaw."

While Mr. Nuttall's specimens may have been secured on Iowa soil the probability seems strongly in favor of a location further west in the then extensive territory of Missouri.

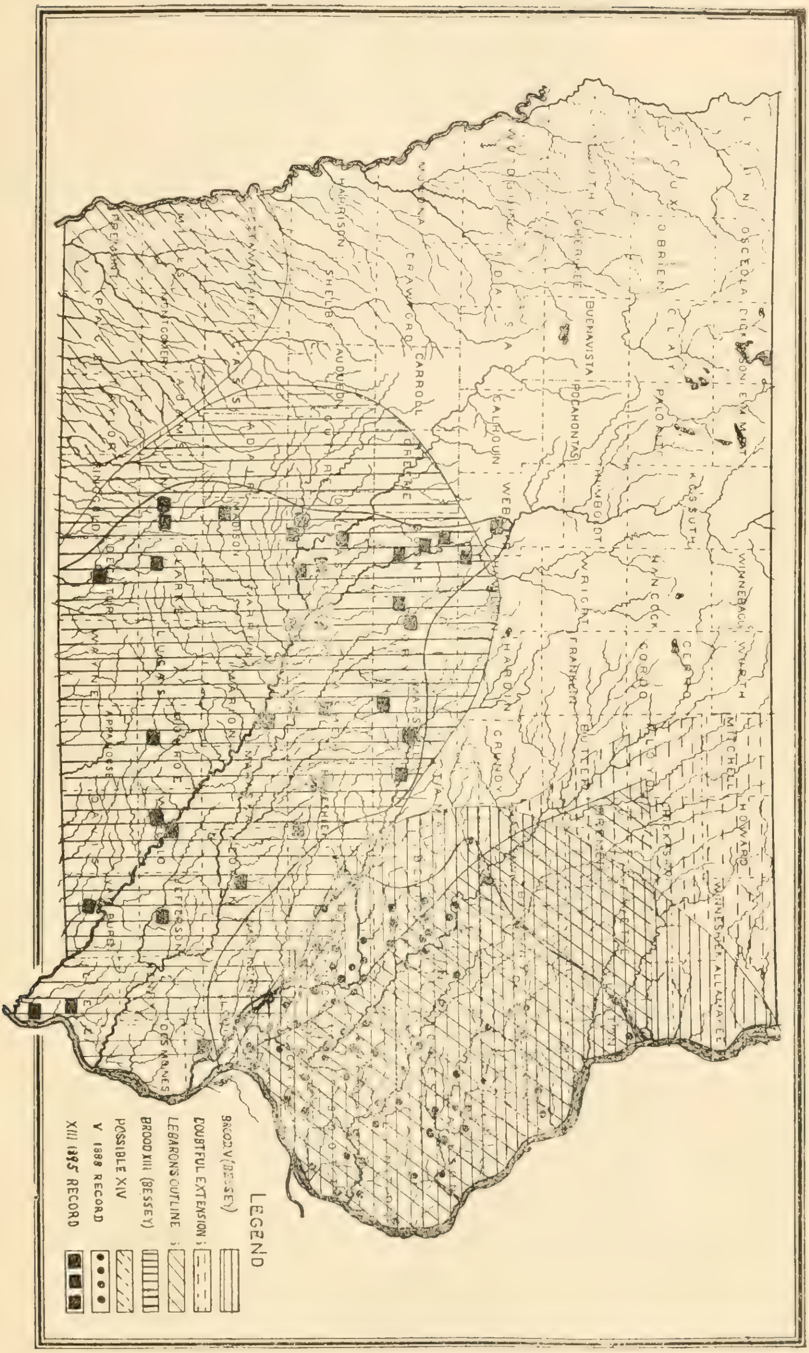
But slight mention has been made of the species since that time and if it is found in the Mississippi valley as a species at all common, it has failed to receive due mention. It is collected in abundance in the Rocky Mountain region, and I have numerous specimens from Colorado and New Mexico.

Aside from the depauperate form to be mentioned further, I have specimens from Tama county, collected by Mr. F. A.

Sirrine, of the larger form approaching typical examples also from Worth county, collected by Mr. S. W. Beyer.

It occurs somewhat commonly in the northwest part of the state and probably is responsible for some of the reports of seventeen year Cicada emanating from that quarter. Mr. E. D. Ball, a graduate of the Agricultural college and whose home is at Little Rock, Lyon county, states that it is found quite abundantly throughout the prairie regions of the northwest part of the state and that it was more abundant in the 70's, before the prairies were broken up, than at present. He gives some interesting observations regarding its habits, the most striking being that it occurs on prairie land remote from timber, thus indicating a habit quite different from the other members of the genus. He states that in herding cattle on the ranges years ago, he has seen them as many as four or five to the square rod of grass in localities where the nearest trees were ten miles away and these only bush willows fringing a stream. During the summer of 1893 he carefully observed them in a lot in town. The lot was bordered on two sides by a double row of trees, box-elder and maples. At any time plenty of the cicades could be found or heard in the grass, but careful searching failed to find a single one or any indications of egg deposition. They occur more abundantly in the rich upland grass at the foot of a hill or bordering a meadow, a situation equally favorable to the growth of certain prairie weeds, notably the "shoestring" or Lead plant, *Amorpha canescens*, which has a very tough woody stem, a plant which was particularly abundant in the lot above mentioned. The cicadas were frequently seen on this plant, but no eggs were found. They appear the latter part of June and only live for two or three weeks at most.

The form of this species which occurs at Ames is much smaller and with more extensive orange markings than in the western forms; it is by no means common and no observations have been made as to its breeding habit here. It is so different from the larger Rocky Mountain form that were it not for the intermediate forms occurring throughout the range of the species as a whole, there would be little question as to its being recognized as distinct. This form agrees with the one described by Emmons as *noveboracensis*.


LEGEND
BROOD V (BESSEY)
DOUBTFUL EXTENSION
LEBARON'S OUTLINE
BROOD XIII (BESSEY)
POSSIBLE XIV
V 1888 RECORD
XIII 1895 RECORD
LYON
OSCEOLA
DICKINSON
EMMET
SIOUX
O'BRIEN
CLAY
PALO ALTO
KOSSUTH
WINNEBAGO
WORTH
MITCHELL
HOWARD
WINNESHIEK
ALLAMAKEE
PLYMOUTH
CHEROKEE
BUENA VISTA
POCAHONTAS
HUMBOLDT
HANCOCK
CERRO GORDO
FLOYD
CHICKASAW
WOODBURY
IDA
SAC
CALHOUN
WEBSTER
WRIGHT
FRANKLIN
BUTLER
BREMER
MONONA
CRAWFORD
CARROLL
GREENE
BOONE
HARDIN
GRUNDY
HARRISON
SHELBY
AUDUBON
GUTHRIE
MARSHALL
TAMA
POTTAWATTAMIE
CASS
ADAIR
MADISON
WARREN
MARION
JASPER
POWESHIEK
MILLS
MONTGOMERY
ADAMS
UNION
CLARKE
LUCAS
MONROE
MAHASKA
KEOKUK
FREMONT
PAGE
TAYLOR
RINGGOLD
DECATUR
WAYNE
APPANOOSE
WAPELLO
JEFFERSON
VAN BUREN
DES MOINES
LEE

MELAMPSALTA PARVULA SAY.

This interesting little species has been taken once at Ames and this is, so far as I know, the only record of its occurrence in the state. It is a more southern form, being credited to the southern states as far north as southern Illinois and central Kansas. Very likely it may be found occasionally in the southern part of the state when collectors become more plentiful.

Any addition to these records will be gratefully received and duly credited in future records.

BIOLOGIC NOTES ON CERTAIN IOWA INSECTS.

HERBERT OSBORN AND C. W. MALLY.

The following notes are extracted from Bulletin 32 of the Iowa Experiment Station, and embrace such portions of work upon certain injurious insects as have a biologic interest. We are indebted to the Experiment Station for the use of the figures.

THE GROUND CHERRY SEED MOTH.

(*Gelechia sp.*)

Our attention was called to this insect by Dr. J. C. Milnes, of Cedar Rapids, who reported it as very destructive on wild ground cherries under cultivation; writing further, that this cherry being very prolific and of excellent quality would be a desirable garden plant were it not for the great injury from this pest. The specimens sent contained the insect in the pupa stage.

Cultivated ground cherry at Ames suffered from similar attack, and the pest seems likely to occasion much loss.

Examination of wild ground cherries in the vicinity of Ames revealed a considerable injury from the pest, and steps were taken to secure the early stages and determine as fully as possible the habits of the insect.

Out of 1,000 berries examined 130, or 13 per cent were infested. All of these infested berries contained the pupæ enclosed in a white silken cocoon which filled most of the cavity of the berry, the seeds being entirely devoured. Near the stem end of the berry and opposite the head of the pupa was an opening presumably prepared for the emergence of the moth.

Observations on these berries would favor the conclusion that the larvæ develop within a single berry, no injured berries being found which did not contain pupæ. However, two berries were found with an opening on the side and containing well developed larvæ with very little of the inside of the berry devoured, suggesting that the larvæ, under exceptional conditions migrate from a berry of insufficient food material to a fresh one.

But very few larvæ were found and these during the last week in September. They were at that time mature and apparently ready to pupate; so of the early molts and even of the full grown larvæ we cannot give a satisfactory description. Those observed were rather contracted, spindle-shaped, whitish, with a reddish-brown head, sparsely haired.

Pupation occurs during last two weeks of August and is in nearly all cases completed by the last of the month.

The pupæ are dark brown, six mm. long, and no distinctive characters that would separate them from related species were detected. The cocoon is thin but of tough, close woven silk. In forming the cocoon the larva attaches itself to the blossom end of the berry by means of the caudal prolegs and then builds the cocoon which practically fills the cavity of the shriveled berry.

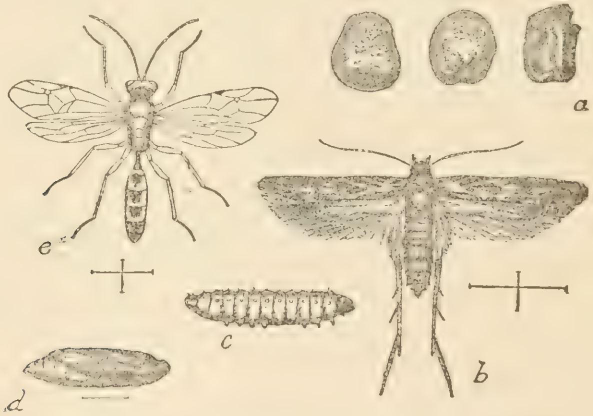


FIG. 1. (*Gelechia sp.*) *a*, injured berries. *b*, moth. *c*, mature larva. *d*, pupa. *e*, parasite *Centeterus suturalis*.

Moths first appeared October 3d, so the period of pupation may be stated as from two to three weeks.

The moth shown at *b* in Fig. 1 is of a gray color with darker spots on the wings. It closely resembles *G. quercifoliella*.

Out of the 130 berries containing pupæ mentioned above we secured four specimens of moths. This low per cent of adults is due to the fact that a large proportion of the pupæ, over 100, were destroyed by a fungus, apparently quite similar to Sporotrichum, and of the remainder a number were attacked by a Hymenopterous parasite (*Centeterus suturalis Ash*), seven of which issued prior to September 24th.

The fungus was not observed to attack healthy berries, always making its appearance after the hole had been made near the stem, and, while it seemed to develop in the tissues of the berry, there seems scarcely any doubt but that it is a parasite of the insect. Some of the Hymenopterous parasites issued from berries showing fungus growth, so that it would appear possible for these to resist the fungus, even when pupæ were infected with it; that is, supposing the fungus to infest primarily the *Gelechia*. Doubtless a parasitized larva would be a more easy victim of fungus attack.

The appearance of moths so late in the season, the impossibility of their producing another brood, and the improbability of their depositing eggs in any situation where they would winter and assure the larvæ access to their food plant the following spring, almost forces us to the conclusion that the moths hibernate and deposit eggs when ground cherries bloom the following season. This view is strengthened by the fact that a specimen was captured in an office room of one the college buildings December 7, 1894. Nevertheless, so long an existence of the adult for so delicate a lepidopterous insect seems doubtful, and the possibility of some pupæ hibernating or of a spring brood of larvæ, even in some situation different from the berries of *Physalis*, must not be overlooked.

This species, as already intimated, very closely resembles *G. quercifoliella*, and it was so determined with some doubt by Mr. Marlatt from specimens sent to Washington for identification. The fact that it affects a totally different plant indicates it to be quite distinct from that species. It is certainly different from *physaliella* as described by Chambers, and has a totally different larval habit, that species being said to mine the leaves of *Physalis* in September, to pupate in leaves and rubbish on the ground, and to issue as adult in April. Still another species described as *physalivorella* was thought possibly to represent our form, though no record of its larval characters or habits were accessible. Mr. Marlatt has, however, kindly compared our specimens with three specimens of *physalivorella* in the National museum, and states, "these are very distinct from your specimen" "The latter agrees quite well with G. quercifoliella, but may be a distinct species."

From this it seems most probable that this insect is undescribed, but we prefer to leave the technical description to some specialist in this group of delicate and inetresting moths.

ON THE EARLY STAGES OF THE IMBRICATED SNOUT BEETLE.

(*Epicaerus imbricatus* Say.)

While this species has been recognized as a pest since its first economic treatment by Walsh in 1863, our knowledge of its life history has remained as meagre as at that time, nothing being known as to its early stages, except the record of egg laying by Professor Forbes.

This led us, on receiving specimens of the beetle with the report of their injury to strawberry plants, to attempt their breeding upon this food plant. While we did not succeed in tracing the full history of the species, the securing of eggs and the partial development of the larvæ, and the possibility that this clue may assist in the further elucidation of its history is our excuse for presenting this fragmentary account.

On May 14, 1895, the adults were placed on a strawberry plant having three or four open leaves and a number of small berries. They immediately crawled up the stems and soon began feeding upon the leaves, cutting a crescent corresponding to a line described by the end of the snout. The crescent was apparently quite uniform but soon became irregular when the beetle had to move in order to reach the tissue; so in reality there is no regularity in devouring the leaf and finally nothing is left but the veins and a few angular fragments of leaves. By the following day the effect on the leaves was quite apparent, the beetles eating rapidly, and by the 20th the leaves were all devoured except a few dry, curled pieces and the stems. They did not attack the berries, but in some cases ate the sepals at the base.

The beetles began pairing the first day and continued for five or six days. No eggs were observed till the 21st when a number of small, white, glistening eggs were found under a fold of a leaf and as no folded or dry leaves had been left on the plant these eggs had certainly been deposited by the *Epicaerus*. On the 22d another leaf containing eggs was found and these, with those previously found, were placed by a fresh leaf that had been carefully freed from all matter that might possibly contain eggs of other species, and the beetles removed to avoid possibility of their injuring the egg. The eggs appeared in all cases to be protected by a fold of leaf carefully glued down.

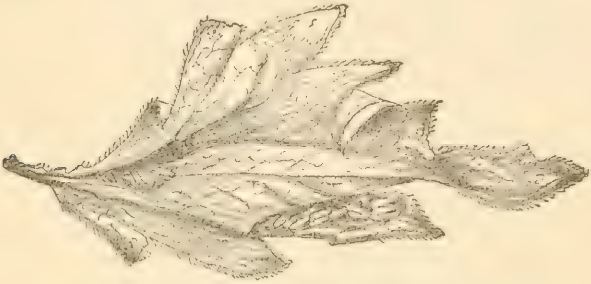


FIG. 8. *Epicaerus imbricatus* eggs. (Drawn by Miss King.)

Forbes[1] says of *Epicaerus* that they "were found by experiment to feed freely on pear leaves, and also to lay their eggs upon these leaves, concealing their deposit by gumming another leaf to the surface."

The eggs are 1.3 mm. long, glistening white, nearly cylindrical, sometimes very slightly curved, the ends broadly rounded, the surface smooth, transparent and the shell very thin.

The first larvæ to hatch escaped before being seen, the empty shells being first noticed on the 30th. Hatching therefore occurs within ten days from time of deposition. Other eggs isolated and kept under close observation showed that the larvæ immediately work their way into the ground and these observed in root cages, during the following three weeks, could be seen to move about among the roots and as they very evidently increased in size and appeared to thrive it is safe to say that they fed upon the roots of the strawberry plant.

The death of the plants in the root cages and the loss of the larvæ unfortunately brought the observation to an end.

The young larvæ are two mm. long, without any trace of eyes or legs. They are yellowish-white in color, the head from above oval with a few strong bristles and the mandibles very conspicuous. The maxillary and labial palpi are short, stumpy and in the living larvæ stand out rather prominently from the under side of the head. The body segments are provided with a few small hairs.

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[1] Sixteenth Report State Entom., Ill., p. 76.

Adult beetles have been observed in autumn, as early as August, but the probability is that only one brood occurs each year, the adults surviving the winter.

This fragmentary result enables us to say with certainty that the eggs are deposited in dry and folded leaves of the food plants of the adults and that the larvæ immediately enter the ground to feed upon the roots. To this extent they show what measures of control must be adopted for this insect.

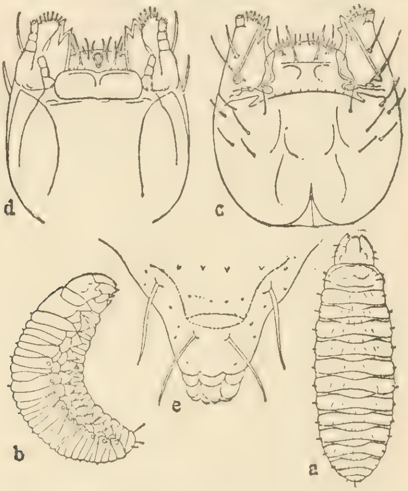

FIG. 9. *Epicaerus imbricatus.* *a*, *b*, young larva, back and side view. *c*, head above. *d*, head below. *e*, terminal segment. (From drawings by Miss King.)

THE COSMOS WEEVIL.

(*Baris confinis Lec.*)

This weevil, Fig. 4, was found September 1, 1895, to work very extensively in the root-stocks and the base of the larger branches of *Cosmos bipinnata* causing the ultimate destruction of the plant. The presence of the insect is first manifested by the breaking off of the larger branches. By examining the base of these branches, and especially the root-stock, it will be

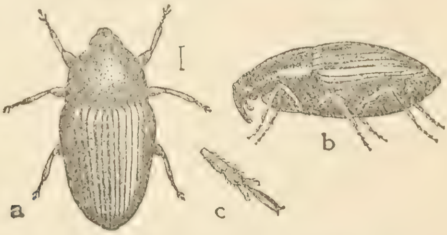

FIG. 10. *Baris confinis.* (Drawn by Miss King.)

found that numerous white larvæ and pupæ about one-eighth inch long are present and working in the woody tissue of the plant. They make small tunnels, packing the borings around them much as does the potato-stalk-weevil. They pupate in these tunnels and emerge as a small black beetle.

The adult when first formed is white and takes on the black color gradually, beginning on the head and thorax and then extending backward to the scutellum and base of elytra and then gradually over the whole body.

The adults are quite active but drop to the ground as soon as disturbed and remain very quiet for some time.

Specimens of the adults kept on plants under observation in the laboratory worked in the young tender tissues, either eating into the terminal portions or into the stems at the axils of the leaves, almost burying themselves and finally causing the small leaf or branch to break down, as do the larger branches. They were not confined entirely to the parts just mentioned but would eat into the little leaflets as they were expanding, thus preventing their complete opening.

One individual was found boring into the end of a broken stem making its way into the pith and almost disappearing in a short time. It remained in that position for some time. Thinking that it might be a female and that the eggs were being deposited, the cavity was examined at the end of four or five days, but no eggs were found. This adult was placed on a growing plant and soon began feeding in the young tissues as stated above. On one small plant in the laboratory the young leaves were so badly eaten into that the plant died in a short time.

One specimen was taken while collecting in the woods August 31st. So the species undoubtedly infests other plants besides the one recorded above.

Nothing can be stated concerning oviposition and the early larval stages. As stated above, numerous fully grown larvæ and pupæ were found in the root-stock and base of the larger branches September 1st. A few fully colored adults were found a few days later. One root-stock was isolated during the second week in September and adults kept gradually issuing until about the middle of October. From this one root-stock as many as twelve to fifteen specimens issued besides the numerous larvæ and pupæ that were removed for the purpose of examination.

Since no eggs were deposited by the specimens kept under observation and adults were still very active after the plants had all been killed by frost, it is quite safe to say that they hibernate and deposit eggs the next spring, there probably being but one brood each year.

A nearly related species, determined at the Division of Entomology, U. S. Department Agriculture, as *Baris dolosa* Casey, was bred in small numbers from the same stems. It was thought to be the same and differences in appearance due to imperfect maturing, but there is a decided difference in form of thorax and it seems probable that both species breed in the same plant and with practically the same life history.

DESCRIPTIONS.

Larva: Fig. 11, a. The fully grown larva is about 5-32 in. long and 1-16 in. diameter, and a yellowish-white color; head light brown, mandibles reddish-brown; legs represented by mammiform protuberances. The body tapers somewhat toward posterior end, the last segment usually showing four bristles.

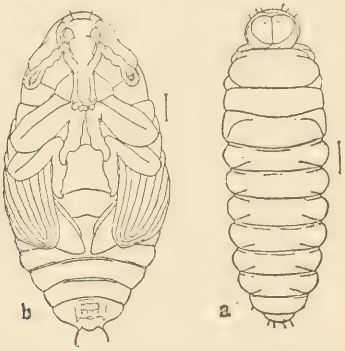

FIG. 11. *B. confinis.* *a*, larva. *b*, pupa.

Pupa: Fig. 11, b. About the same length as larva, but comparatively wider. Head (from beneath) fits closely to the body, eyes not especially prominent; antennæ wide in proportion to the length, normally not projecting beyond the sides of the thorax, club conspicuous, usually somewhat denser in appearance. Snout reaches base of first pair of legs and shows small, roundish portions at tip corresponding to the mouth-parts. First and second pair of legs clumsy in appearance; joints of the tarsi indicated, the last one distinctly curved; third pair of legs hidden, only a slight portion being visible along the inner margin of the hind wing-pads. Four abdominal segments visible for their entire width. The last segment usually has two apical bristles and a group of small spiny processes.

Adult Fig. 10. (a, dorsal view; b, side view; c, tarsus.) Widest at base of elytra and tapers strongly toward either end; shining black, glabrous; numerous medium sized punctures on the thorax and between the striæ of the elytra. Snout about 1-24 inch long, curved, usually extending directly downward, but sometimes drawn backward or slightly projected forward. Thorax narrows perceptibly toward the head. Tarsi strongly pubescent beneath, claws strongly curved, diverging. Elytra emarginate at tip, making the tip of abdomen more distinctly visible from above.

REMEDIES.

Collecting and burning the old root-stocks and stems in early autumn will be the most effective treatment that can be suggested from present knowledge of the species.

AN INSECT OCCURRING IN WATER TANKS AND RESERVOIRS.

(*Chironomus sp*)

Early in July I received some specimens of a slender red larva from Boone, with the following letter:

Professor Osborn:

DEAR SIR—Enclosed I send a sample of the worm that appeared in our city water about a week ago in countless numbers. Would like to know what they are and where they would be likely to come from. The water we use comes from a 3,000-foot well, but about two weeks ago our pumps failed and we were supplied with water from a forty-five foot vein owned by the C. & N. W. Ry. Co., and pumped to our reservoir through a hose.

Yours truly,
E. E. CHANDLER,
Chairman Water Committee.

Boone, Iowa.

The larvæ were evidently *Chironomus*, and in replying to the letter it was so stated and that in themselves they could be considered harmless, though of course the presence of masses of such ugly looking creatures would be objectionable, and if dying in the water they might become a source of pollution Also that the larvæ must have gained access to the water from the eggs of the adult mosquito-like insect being deposited in the reservoir or the mains by which it was filled. They could not be derived from a deep well. It was suggested that provision be made to exclude the insects from the water to prevent deposition of eggs.

The larvæ (Fig. 12) *a* and *b* ,which are an inch or a little more in length and of a light red color with green reflections on the sides near the head, construct a tube at the bottom of the water in which they live, and in this remain protected and from it extend themselves to obtain food. The food is for the most part apparently minute aquatic organisms, algæ, etc. Their presence might be considered a means of clearing water of such matter did they not at times become so numerous as to prove an element of danger.

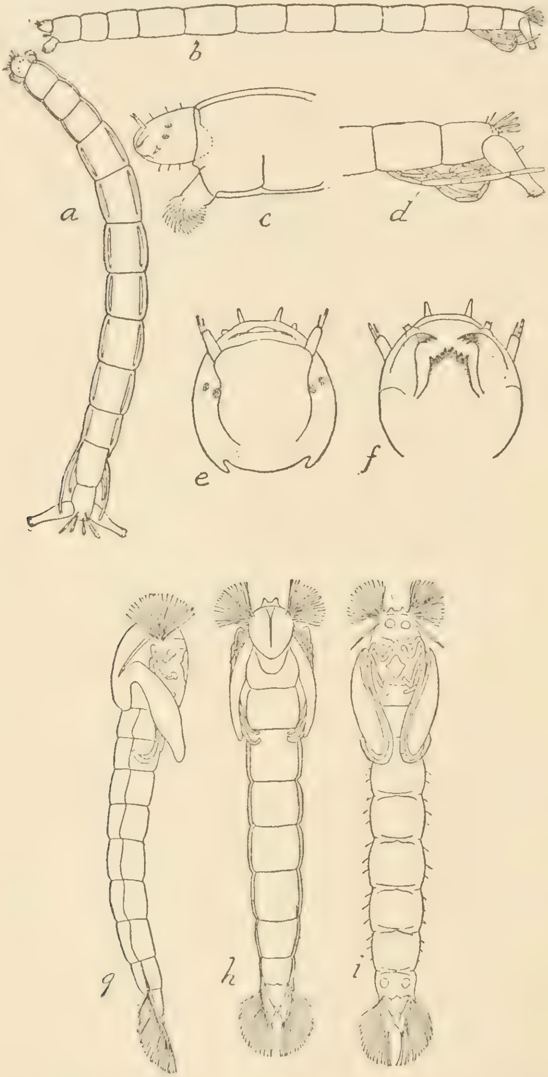

FIG. 12. (*Chironomus sp.*) *a*, larva, dorsal view. *b*, side view. *c*, head and first segments of body. *d*, terminal segments of body showing appendages. *e*, upper surface of head. *f*, lower surface of head. *g*. side. *h*, dorsal. *i*, ventral view of pupa. (Original, drawn by Miss King.)

Later in conversation with Mr. G. W. Brown, a civil engineer of Boone, it was learned that the water was pumped into a large cement-lined reservoir which contained the larvæ in immense numbers and was without question the point where the eggs were laid, it being exposed to easy access by insects. It appeared also that the larvæ were drained into the mains at times when the reservoir was low, doubtless causing strong currents over the bottom. Specimens have also been received from Des Moines.

When mature they change to a delicate pupa (Fig. 12, *g*, *h*, *i*,) and then rise to the surface of the water and soon the adult insect escapes from a slit along the back of the pupa case.

The adult is a delicate mosquito-like insect (Fig. 13.) belonging to the genus *Chironomus* but it cannot be referred to any of the described species and the present state of the classification of this genus is such as not to warrant us in giving it a scientific name or description.

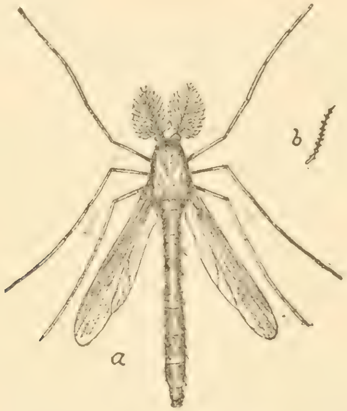

FIG. 13. (*Chironomus sp.*) *a*, adult male. *d*, antenna of female. (Original).

The insect is of interest at this time because of the great number of water tanks and reservoirs established, not only in cities and towns, but on many farms, and the probability of its frequent occurrence where these are open to visits of the adults.

Exclusion of the adults, where practicable, may be accomplished by the use of ordinary mosquito netting or wire gauze. Where this is impracticable the providing of an inlet to distributing pipes that will draw water from a few inches above the bottom of the reservoir (which might further be protected by a fine screen) will, it is believed, avoid the distribution of the worms in the mains.

CONTRIBUTIONS TO A KNOWLEDGE OF THE THRIPIDÆ OF IOWA.

ALICE M. BEACH.

This paper represents the results of a study of some of the Thripidæ of Iowa, and is based upon an examination of material found in the collection of the Iowa Agricultural College, some specimens kindly loaned by Miss Emma Sirrine, Messrs. F. A. Sirrine and C. W. Mally, and some in the writer's own collection. Descriptions of seven new species and three new varieties are herewith presented, including a new species of Phlœothrips described by Prof. Herbert Osborn. The descriptions are preceded by an artificial key, arranged to aid in the identification of all the described Iowa species known to the author. The table for the determination of genera is substantially that found in Comstock's Introduction to Entomology, pp. 125-127. The writer is indebted to Mr. Pergande for an outline of the characters of Euthrips, and is under special obligations to Professor Osborn for valuable aid in the prosecution of this work which has been done in the Entomological Department of the Iowa Agricultural College.

TABLE FOR DETERMINATION OF GENERA.

A. Last abdominal segment in both sexes elongated, narrow, tubular; both pairs of wings similar, veinless, margins equally ciliated; maxillary palpi two-jointed; borer in female absent .... Sub-Order I. Tubulifera.
  B. Contains but a single family .... Fam. I. Tubuliferidæ.
    C. Contains but a single genus .... Gen. 1. Phlœothrips.
AA. Last abdominal segment not elongated and tubular in both sexes; both pairs of wings unlike in structure, front wings always veined; margins unequally ciliated; maxillary palpi three-jointed; borer in female present .... Sub-Order II. Terebrantia.
  B. Females with borer curved upwards .... Fam. II. Stenopteridæ.
  BB. Females with borer curved downwards .... Fam. III. Coleoptratidæ.

FAM. II. STENOPTERIDÆ.

A. Body above netted with elevated lines..........Gen. 2. Heliothrips.
AA. Body above smooth.
B. Abdomen clothed with silky hairs; apex conical, formed alike in both sexes..............................Gen. 3. Sericothrips.
BB. Body smooth; apex of abdomen unlike in the two sexes.
C. Prothorax produced in front, and narrowed..Gen. 4. Chirothrips.
CC. Prothorax not produced in front and narrowed.
D. Last segment of abdomen with a pair of spines in female; male, wingless......................Gen. 5. Limothrips.
DD. Last segment of abdomen unarmed.
E. Last two segments of antennæ shorter than the sixth segment..........................Gen. 6. Thrips.
EE. Last two segments of the antennæ longer than the sixth segment.................Gen. 7. Belothrips.

FAM. III. COLEOPTRATIDÆ.

A. Antennæ with nine distinct segments..........Gen. 8. Melanthrips.
AA. Antennæ apparently five jointed, the last four segments being minute and compact
B. Body somewhat flattened; meso-metathorax broad; front wings without fringe on costal border, and with four distinct cross veins; males with lateral abdominal appendages..Gen. 9. Coleothrips.
BB. Body cylindrical, mesothorax and metathorax constricted, wings rudimentary..............................Gen. 10 Aeolothrips.

SYNOPSIS OF IOWA SPECIES.

GENUS PHLŒOTHRIPS, HAL.

A. Proximal joint of anterior tarsi armed with a tooth on inner side ..1
AA. Proximal joint of anterior tarsi unarmed..............................2
1. With postocular bristle; three bristles on each side of prothorax; antennal joints 3-6 yellow................*verbasci*, Osb.
Without postocular bristle; a single bristle at each posterior angle of prothorax; antennal joint 3 and base of joint 4, sometimes base of joint 5, yellowish...................*nigra*, Osb.
2. Black; head slightly longer than wide; tube three times as long as wide....................................*caryæ*, Fitch.
Purplish-black; head one and one-half times as long as wide; tube twice as long as wide........................*mali*, Fitch.

Phlœothrips verbasci, Osb.

Description follows this paper.

Phlœothrips nigra, Osb.

Can. Ent., Vol. XV, p. 154 [1883].

Phlœothrips caryæ, Fitch.

[Third Report.] Trans. N. Y. State Agr. Soc. for 1856, Vol. XVI, p. 446.

Phlœothrips mali, Fitch.

[First Report.] Trans. N. Y. State Agr. Soc. for 1854, Vol. XIV, p. 806.

GENUS HELIOTHRIPS, HAL.

This genus is represented in the collections by a single species, *H. hœmorrhoidalis*, Bouché. It is probable that *H. dracænæ* Heeger also, which occurs frequently in hothouses in this country and in Europe, is found in this state. These two species may be separated as follows:

Fuscous, apex of abdomen ferruginous; antennæ and feet pale; first and second joints of the former fuscous, sixth joint black---------------- *hæmorrhoidalis*, Bouché.

Yellowish-brown; wings white, sub-fasciate with brown--*dracænæ*, Heeger.

Heliothrips hœmorrhoidalis, Bouché.

Naturgeschichte der schädlichen und nützlichen Garten-Insekten, p. 42 [1833].

Heliothrips dracœnœ, Bouché.

Sitzungsb. d. mathem—naturw. Klasse d. Wissensch., Vol. XIV, p. 365 [1854].

GENUS SERICOTHRIPS.

One species, *Sericothrips? perplexa*, containing representatives of the male sex only, has been doubtfully referred to this genus. This species possesses well marked characters, evidently of generic importance, which do not accord with those of any genus of this family with which I am familiar. They are as follows: Head somewhat flattened or depressed and produced in front with the ocelli placed very far forward; fourth antennal joint decidedly longer than the third, apex of abdomen in male formed like that of females of this family. In Burmeister's Handbook of Entomology, Vol. 2, p. 413, the genus Sericothrips is characterized as having the abdomen covered with silky hairs, head hidden up to the eyes in the thoracic segment and the tip of the abdomen formed alike in both sexes. In the enumeration of species, the same authority records but a single species, hence it may prove that a more extended knowledge of allied forms will make it necessary to enlarge the limits of the genus, therefore it seems best to place this species here provisionally rather than to erect a new genus.

Sericothrips? perplexa, n. sp.

Male: Length, 1.33–1.55 mm. General color fuscous; legs and annulus on antennæ yellowish; thorax tinged with yellow-ferruginous; abdomen except apex, varying from pale to deep fuscous; anterior wings subfuliginous, clearer at base. Form slender; bristles and spines short, inconspicuous; head, from dorsal view, subpentagonal; antennæ seven-jointed, approximate; ocelli placed very far forward toward front border of head; posterior angles of prothorax bisetose; spines on cubitus 15-16, arranged in a basal series of three or four followed by an intermediate group of nine, and this by two, more widely separated, at distal end of vein.

Head, seen from above, subpentagonal, its greatest length equal to its greatest width; sides constricted behind eyes; front margin produced, and subangulated in middle, its width almost completely occupied by the antennæ; eyes dark red-brown, of medium size, moderately granulated, pile scattered, long; posterior orbits depressed. with a row of short sparse hairs parallel to them; vertex scarcely elevated, gradually descending toward apex where it merges into the front; ocelli yellow, inner margins red; anterior ocellus on upper margin of front; lateral ocelli contiguous to upper orbits; ocellar bristles moderately long; small bristles between anterior ocellus and the eyes; occiput striate, provided with two weak bristles; front produced to base of antennæ thence receding toward clypeus, furnished with a row of four weak bristles just beneath antennæ and two similar bristles near clypeal margin. Antennæ seven-jointed, approximate, base plainly visible from above; joint 1 shortest and thickest, one-half the length of the second; joints 2-4 increase in length in the order named; joint 4 is nearly as long as joint 6, which is larger than any other joint; joint 5 is slightly longer than the second and more slender than any of the preceding; joints 6 and 7 are closely united and together pyriform in shape; the latter is nearly one-half the length of the former; the first joint is subrotund; the second, somewhat barrel-shaped; the third subfusiform; the fourth and the sixth elongate-ovate; the fifth submoniliform; the seventh lanceolate, its base narrower than the apex of the sixth; bristles and sensorial spines of joint 4 placed nearer the middle than usual.

Prothorax subquadrate, scarcely broader than head; sides very slightly constricted at anterior border; posterior angles narrowly truncate, provided with two bristles; shorter bristles or hairs are scattered over a triangular area extending backward from the front margin, and a smaller area near the posterior angles; anterior angles provided with equally small, but heavier bristles; surface apparently smooth; mesoscutum broadly convex, nearly smooth, furnished with short inconspicuous bristles each side and two submedian bristles on disc. The scutellum, obtusely ridged, feebly sculptured, provided with two short, heavy, approximate bristles on ridge near basal margin.

Abdomen slender; apex abruptly conical, resembling that of females of this family; sides distinctly sculptured; segments with a few bristles or coarse hairs laterally and on apical border of their ventral surface; caudal segments with longer and stronger radiating bristles arranged in two rings as in females.

Legs slender; anterior femora scarcely expanded; posterior tibiæ spiny on inner margin and at apex; their tarsal joints with apical spines. Anterior wings lanceolate, humeral angle moderately arched; cubitus extending entire length of wing; radial vein obsolete at base and nearly obsolete at tip; costal spines, 22-24; cubital spines, 15-16, arranged in groups, three or four at base, followed by a group of nine, and this by two more widely separated, placed at distal end; radial spines, 13; anal spines, 5; longitudinal vein of posterior wing distinct.

General color fuscous; third and fourth joints of antennæ entirely and sometimes base of fifth, legs, except more or less of dorsal surface, yellowish: thorax, especially the sutures, tinged with yellow-ferruginous: abdomen varying from fuscous to yellowish or pale fuscous; apex always dark; dorsal aspect of femora generally concolorous with head; anterior wings subfuliginous with a broad, indistinctly defined, pale sub-basal band: posterior wings subhyaline.

Described from eleven specimens taken at Ames, Iowa, on *Cyperus*, corn and in sweeping grass in August and November.

GENUS CHIROTHRIPS, HAL.

This genus is represented by a single species, *Chirothrips antennata*, Osb., which is of a brownish-black color with third joint of antennæ paler; second joint is quite characteristic, being trapezoidal with acute angle outward.

Chirothrips antennata, Osb.
Can. Ent. Vol., XV, p. 154. [1883.]

GENUS THRIPS.

A. Head of medium size; eyes moderately prominent; antennal joints 3-5 elongate 1
AA. Head small; eyes very prominent; antennal joints 3-5 not elongate 8

1. Antennæ eight-jointed 2
   Antennæ seven-jointed 7
2. Sixth joint of antennæ annulated 3
   Sixth joint of antennæ not annulated 6
3. Ocelli widely separated; long bristles at all angles of prothorax; spines present at apex of all tibiæ, numerous and heavy on wings, on radial vein 12-14 4
   Ocelli subapproximate; single bristle of medium length at each posterior angle of prothorax, none at anterior angles; spines present at apex of posterior tibiæ only, on radial vein 2 5
4. Size medium; head, from dorsal view, rectangular; antennæ approximate .... (*Euthrips*) *tritici* Fitch.
   Size large; head from above pentagonal; antennæ subapproximate .... (*Euthrips*) *maidis* n. sp.
5. Wings more or less distinctly clouded; brown markings on thorax and band at base of abdominal segments 2-7 distinct .... *variabilis*, n. sp.
   Wings nearly uniformly fuliginous; brown markings distinct on thorax; abdomen immaculate .... var *a*.
   Wings and body, pale; markings, obsolete .... var. *b*.
   Wings distinctly trifasciate; broad brown band on head

and thorax respectively; abdominal segments 1-3 and 7-10 entirely brown ....var. *c*.

6. Head, from dorsal view, semiovate; ocelli subapproximate, conspicuous; spines and bristles, short and few; bristles on penultimate segment of abdomen equally long ....*striata*, Osb.
   Head, from dorsal view, subrectangular; ocelli remote, inconspicuous; single strong bristle at each posterior angle of prothorax; intermediate bristles on penultimate segment of abdomen, one-half as long as lateral bristles, *inæqualis*, n. sp.
7. Size medium; antennæ sub-approximate; ocelli inconspicuous; prothorax, transverse; bristles at posterior angles of medium length; spines at base of cubitus arranged in two groups..*tabaci*, Lind.
   Size large; antennæ approximate; ocelli, conspicuous; prothorax, subquadrate; bristles at posterior angles of prothorax, long; spines at base of cubitus in single group ...*lactucæ* n. sp.
8. Antennæ eight-jointed; ocelli approximate; spines and bristles, except those on abdomen, long and slender; bristle at middle of each lateral margin of prothorax, one at each anterior and two at each posterior angle.............*pallida*, n. sp.

Thrips (*Euthrips*) *tritici*, Fitch.

[Second report.] Trans. N. Y. State Agr. Soc. for 1855, p. 536; Osborn Can. Ent., Vol. XV, p. 156 (1883).

Thrips (Euthrips) maidis n. sp.

Female. Length, 1.83-2.mm. A large species slightly variable in color, brownish-black, but sometimes paler; annulus on antennæ, extremities of femora and tibiæ, lower surface of the latter and sutures of abdomen yellowish-white; thorax, especially its sutures, tinged with yellowish-ferruginous; anterior wings dusky white; head pentagonal, front margin produced and rounded in the middle; ocelli distant, antennæ subapproximate; spines and bristles strong, blackish, arranged much as in *E. tritici*, Fitch; costal spines 25-29; cubital, 19-23; radial, 15-16; anal, 5; internal, 1.

Head, from dorsal view, pentagonal, scarcely broader than long; its sides parallel; anterior border produced and rounded in the middle; occiput less than one-half the length of the head measured on a median line, plainly striated; genæ uniformly full; eyes rather large, coarsely granulated, feebly pilose; orbits yellow, encircled with a few short hairs; ocelli, pale yellow, margined with red crescents, widely separated and arranged in a broad triangle with its lateral angles contiguous to superior orbits; vertex broad, gently convex between lateral margins; produced cephalad and provided with a transverse row of four short hairs near its anterior margin; the front wide with medial, longitudinal elevation; antennal sockets occupying less than its entire width, making antennæ subapproximate, more widely separated than in *E. tritici*, Fitch; antennal joints 3 and 4, occasionally base of 5, white, the rest, black; joint 1 globose, more than one-half as long as joint 2; the latter subglobose, somewhat contracted toward base, both joints more robust than those following: joints 3–5 elongate, submoniliform, decreasing in size in the order named; the third nearly as long as the sixth; apical joints subequal, minute; all joints thinly covered with microscopic hairs; bristles or stiff hairs on basal and intermediate joints which on distal joints are replaced by slender hairs; sensorial spines on the third, fourth and sixth joints, distinct; clypeal, subantennal and postocular bristles present, the last less conspicuous than in *tritici;* mouth parts distinctly asymmetrical; each joint of maxillary palpi cylindrical, narrower than the preceding; first and third subequal in length, and second shorter than either.

Prothorax about one and one-half times as broad and equally as long as preceding segment; anterior angles rectangular, posterior rounded, sides slightly converging cephalad; disc striate and sparsely hairy; front and hind borders more deeply striate or rugose, bristly; the most conspicuous bristles are arranged as follows: One long bristle at each anterior and two at each posterior angle; two shorter bristles on anterior margin, two on posterior margin and one on disc near each posterior angle.

Meso-metathorax, subquadrate; mesoscutum more finely striate than prothorax, with small bristles, one at each lateral angle, two near and two on posterior margin; scutellum as long as mesoscutum, narrow, not strongly carinate; base transversely striate, sides longitudinally rugose; basal bristles as in *tritici.*

Abdomen broad, ovate, basal segments and sides sculptured, bristles similar to those of *tritici.*

Legs, with numerous short bristles; all tibiæ and joints of posterior tarsi with terminal spines; anterior femora incrassate, their tibiæ stout.

Wings rather broad; humeral arch not prominent; surface minutely pilose; veins distinct, uniformly and heavily spinose; anterior and posterior basal cross veins present; cubitus inserted in marginal at tip of wing; radius obsolete at proximal end, but perceptible before it unites with the posterior basal cross vein; costal spines longer than those on the other veins, numbering from twenty-five to twenty-nine; cubital, from nineteen to twenty-three; radial, from fifteen to sixteen; anal, five, gradually increasing in size from one to five; internal, one; posterior wings hyaline; longitudinal vein indistinct, except at base.

This form approaches closely the dark colored specimens of *tritici,* from which it may be separated by its larger size, the annulus on the antennæ, and especially by the shape of the head, which is pentagonal instead of rectangular, and the less approximate antennæ.

Described from twenty-nine specimens taken at Ames, Iowa, in July, August, September and January.

Thrips variabilis n. sp.

Head transverse Antennæ eight-jointed, distant; ocelli approximate. Each posterior angle of prothorax provided with a single medium sized bristle; bristles on penultimate segment of abdomen not strongly radiating, not extending backward beyond the base of the succeeding row; radial vein bispinose, obsolete; legs slender.

Female. Length from .84–1.23 mm. Head one-half as long as broad; viewed from above, subrectangular; anterior margin straight; occiput short, transversely convex and striate; distinct oblique depression behind each eye; genæ moderately full; vertex abruptly ascending, tumid across whole anterior border; ocellar area small, elevated; ocelli approximate, inner margins heavy, conspicuous: ocellar bristles not more than one-half the length of the head; eyes large, prominent, feebly pilose. Antennæ eight-jointed, distant, moderately bristly; basal joint short, thick, hidden from dorsal view by vertex; the following joint longer, more robust, globose; joints 3–6 elongate; joint 3 the longest, subfusiform; joint 4 a little shorter than joint 3, elongate-modioliform; joint 5 obovate, intermediate in length between 2 and 4; the remaining joints sessile, together elongate-conical; joint 6 equal to joint 4 but a little stouter; joints 7 and 8 minute, together one-half as long as preceding, line of separation between them oblique; sensorial spines on joint 6 originate beyond middle; four short bristles in transverse row on front above antennæ, and one behind each eye; mouth parts nearly symmetrical.

Prothorax broader than long; anterior angles prominent, rectangular; posterior angles broadly rounded and furnished with a single bristle; surface plainly and uniformly marked with transverse striæ, with a few short slender bristles on front margin and more on disc. Mesoscutum is quite convex from base to apex, marked with fine transverse striæ, and provided with four short bristles on disc. Scutellum with triangular area at base striate as in mesoscutum, furnished with four basal bristles.

Abdomen broad, ovate; sides, under high power, appear thickly set with minute appressed hairs; a pair of bristles occurs on disc of each segment from the second to the seventh; they are approximate on the second and gradually become more widely separated on the succeeding segments; lateral bristles few and short; apical border at sides and on ventral surface of segments bordered with minute ciliæ interspersed with coarse hairs or bristles; caudal spines rather light; those on penultimate segment directed backward and extending only to base of following segment; terminal spines a little longer than the preceding, radiating at sides.

Legs very slender, somewhat bristly; tarsi elongate; anterior femora not dilated; apex of intermediate and posterior tibiæ and of posterior tarsal joints terminating in short spines; inner margin of posterior tibiæ feebly spinose.

Wings; veins heavy; in anterior pair radius and cross veins obsolete; costal spines number 22-30; cubital, 20-26, arranged in two series; radial, 2; anal, 4; one near base of anal cell; longitudinal vein of posterior wing very heavy for two-thirds of the length.

Male. Length, 78-86 mm. Resembles the female very closely. Differs in being of smaller size, in having from 23-25 costal spines, 20-21 cubital: the remaining spines on the wing as in female. The apex of the abdomen is more blunt; the anal segment is cleft on either side, the lateral lobes terminate in two spines; the middle lobe is prolonged considerably beyond the lateral lobes, making apex more pointed than apex of male of *T. tritici*. The spines on preanal segment are similar to those in female.

This species presents considerable variation in color. The extreme forms are quite distinct and might almost be considered separate species were it not that in addition to the similarity in structure there is the occurrence of a series of intergradient forms.

Var. *a*. Female: General color yellowish-white, meso-metathorax pale yellow, basal joints of antennæ concolorous with head, joint 3 and base of joint 4 dusky; the remainder of the antennæ and spot at distal end of tarsi, brownish-black; eyes dark red-brown; ocelli nearly colorless; inner margins red; anterior wings indistinctly clouded with fuliginous at base, distal portion clearer; brown markings as follows: A clearly defined saddle-shaped patch on posterior portion of prothorax, concave along its front border, nearly interrupted by a wedge-shaped incision extending forward from posterior border; anterior border of mesonotum; scutellum except median stripe; bands at base of abdominal segments two to seven, dilated at sides, and narrower and fainter along intervening space; patch on upper side of all the femora, darkest on posterior pair.

One specimen, taken on clover August 14, 1893, and one on hackberry, October 6, 1893, Ames, Iowa.

Another specimen taken on hackberry, October 6, 1893, at Ames, Iowa, corresponds with the description of variety *a* except that the thorax is a deeper yellow.

Another specimen taken on elm, August 21, 1894, is more uniformly yellow, the anterior wings more uniformly dusky, bands at base of abdominal segments narrower and other markings fainter.

A fourth specimen that may be placed in this group resembles the first, but it is of a deeper yellow color; the markings on the prothorax are prolonged farther backward, and the wings are more uniformly fuliginous. Ames, Iowa, Oct. 8, 1893.

Var. *b*. Male and female: Body pale yellowish, immaculate; apical joints of antennæ black, remainder pale; wings and fringes tinged with yellowish.

Hawthorn and hackberry, Ames, Iowa, October 6, 1893.

Var. *c*. Male and female: Wings nearly uniformly fuliginous; last three joints antennæ, distal half of joints 4 and 5 black, sometimes intermediate joints altogether dusky; brown markings very distinct, confined to two large spots on thorax and scutellum respectively, the latter oblong and approximating posteriorly; abdomen immaculate.

Hawthorn and hackberry, October 6, 1893, Ames, Iowa.

Var. *d*. Male and female: This variety is characterized by having the wings fuliginous, trifasciate with white bands, and in being more heavily marked with brown; the markings on the thorax and bands at base of first, second and third (sometimes of second and third only), and seventh and eighth segments of the abdomen are extended until they coalesce and form broad bands; the dorsal surface of the head is brown; sometimes all of the caudal segments are brown; the legs are white, with brown streaks on dorsal surface of femora, and frequently on tibiæ also; antennæ as in preceding variety.

On smartweed, June 16, 1893, and on cucumber, July 28, 1893, Ames, Iowa.

By the shape of the head and by the antennal characters this species is allied to *T. tritici*, but it may readily be distinguished from it by the smaller and more approximate ocelli, the absence of large conspicuous bristles on the thorax, the difference in the number of spines on the wing, and the more slender legs.

Thrips (*Euthrips*) *striata*, Osb.
Can. Ent., Vol. XV, p. 155.

Thrips inequalis, n. sp.

Female: Length, 88 mm.; yellow; style and distal portion of antennal joints, 3-6, black; joint 6 distinctly annulated toward apex; posterior angles of prothorax with a single bristle; lateral bristles on dorsum of penultimate segment of abdomen twice as long as intermediate pair.

Head, broader than long, contracted at posterior border, occiput forming not more than one-half of its dorsal surface; genæ uniformly full; eyes of medium size, moderately prominent, distinctly pilose; vertex uniformly tumid at anterior margin, becoming transversely convex and descending toward posterior margin; ocelli subapproximate; front, above insertion of antennæ, longitudinally elevated along median line.

Antennæ subapproximate; the two basal joints stout, subequal; the second barrel-shaped, more than one-half as long as succeeding; joints 3-6 subequal in length and less elongate than in *T. tritici;* joints 3 and 4, thick, irregularly turbinate, gibbous below insertion of sensorial spines; joint 5, smaller and more regular in shape; the remaining joints form an elongate oval; joint 6 has a distinct articulation on distal half, similar to the annulation on the sixth antennal joint of *T. striata*, Osb.; this may be an indistinct annulation, in which case the antennæ would be properly considered nine-jointed, three of the joints forming the style; the ultimate joint is nearly cylindrical and longer than the penultimate, which is of the same length as that portion of the joint 6 between the annulation and the apex; the joints are furnished with a few medium-sized bristles or stiff hairs, which become finer toward the distal end of the antennæ; sensorial spines as in *T. tritici.*

The prothorax is one and one-half times as long as the head, equally as broad at anterior border and about one-third broader at posterior border. The disc is convex, rather indistinctly striate and sparsely set with stiff, blackish hairs or bristles, which are almost entirely wanting on median portion, and most numerous near lateral and posterior borders. Posterior angles with a single long bristle.

The disc of the mesoscutum is convex, finely striate, elevated at posterior border, provided with a single short bristle near each lateral angle, two on disc and two on posterior margin. The scutellum is trapezoidal, gently sloping from the very small elevated area near base toward posterior and lateral margins; on the basal margin are two widely separated and two short approximate bristles.

The abdomen is ovate, resembling that of *T. tritici*, Fitch, in an arrangement of bristles, except that the median pair on penultimate segment is but one-half as long as those on either side.

Legs, especially femora and tibiæ, thinly covered with short, coarse hairs which are replaced by bristles at apex of anterior and intermediate tarsal joints; inner margin of posterior tibiæ feebly spinose; its apex and apex of its tarsal joints terminating in spines; anterior femora moderately dilated.

Anterior wings nearly attain tip of abdomen: veins heavy; inner marginal vein very distinct; costal fringe rather heavy; costal vein bears from 24–28 spines; radius, 18–19, those on basal half of vein separated into two groups of four each, the intervals between the rest growing wider toward the distal end of the vein; cubitus, 10–11; anal, 5; anal cell, 1.

Color yellow, deeply tinged with orange on thorax and abdomen, faintly dusky along median line of thorax and abdomen; head and two basal joints of antennæ, whitish; proximal portion of joints 3–6, dusky; remainder of antennæ and spot near apex of tarsi, black; eyes, red-brown; ocelli, pale yellow; inner margins, orange-red; spines and bristles blackish; anterior wings and fringes tinged with dusky yellow.

Described from a single specimen taken with *T. tritici* on aster at Ames, Iowa, September 16, 1893.

Thrips tabaci, Lind.

Schädlichsten Insekten des Tabak in Bessar. Abien., pp. 62–63. (1888.)

Thrips lactucæ, n. sp.

Female: Length, 1.40 mm. General color pale yellow, with two broad diverging stripes on middle of thorax, a narrow band at base and one or more spots at sides of abdominal segments brown. Form elongate; anterior border of head convex. Antennæ seven-jointed, proximal joints pale, remaining joints black. Wings variable in size. Ocelli conspicuous, placed close together near posterior margin of vertex. Spines and bristles stout, on thorax, arranged much as in *T. tritici;* the cubital spines are grouped into two series, a basal group of seven, followed by three, more widely separated, on distal portion of vein.

Head scarcely broader than long; outline seen from above semiovate; occiput, feebly striate, one-half the length of the head, with shallow, longitudinal furrow each side behind the eye; genæ, broad, full, prolonged posteriorly; vertex elevated, convex between the eyes, ascending and expanding towards apex, front margin arcuate; ocelli conspicuous, remote from anterior border of vertex, inner margins heavy, contiguous in front; ocellar area elevated; ocellar bristles of medium size; eyes, moderate, pilose; a row of bristles on front, beneath insertion of antennæ, is partially visible from above; a few microscopic bristles around orbits; antennal sockets prominent, easily seen from above; antennæ approximate, seven-jointed; the intermediate joints elongate; joint 1 is one-half the length of joint 2, equal to or longer than joint 7, semiglobose; joints 2-5 are subequal in length; joint 2 is cupshaped, a little shorter but much stouter than any of the three immediately following; joints 3-5 are moniliform;

pedicel of 3 is short; joints 6 and 7 together form an elongate oval; the latter is acuminate at apex two-fifths the length of the former and terminates in two or three long slender hairs; surface of all the joints set with minute appressed hairs and furnished with a few bristles which are arranged in a preapical ring on joints 2-5, and on remaining segments are replaced by slender hairs; sensorial spines on joints 3, 4 and 6, distinct.

The prothorax is subquadrate, a little longer and wider than preceding segment; posterior angles nearly rectangular; posterior border margined; surface nearly smooth and, with the exception of two discal areas, covered with coarse, stiff hairs which are largest near lateral and posterior borders: two short bristles at each anterior angle and four longer ones near front border; two large, strong, subequal bristles at each posterior angle, two of moderate length on hind border, and a similar one on disc near each posterior angle.

The surface of the mesoscutum is apparently smooth, its posterior discal portion only moderately elevated, provided with two small bristles; two similar bristles occur on the posterior border, and one at each lateral angle. The metanotum is very short. The scutellum is obtusely carinated, its surface longitudinally striate, provided with two approximate submarginal bristles on anterior portion of disc, and two, more widely separated, on basal margin.

Abdomen is quite uniform in width, convex above, striate at base and at sides; base slender; apex short, conical; segments constricted, bearing a few stiff hairs on dorsal and ventral surfaces and a few bristles at sides; both hairs and bristles become stronger on anal segments, where the latter are arranged in two rings.

Legs, especially posterior pair, slender; anterior femora but slightly expanded; hind tibiæ spiny on inner margin, terminating in three strong spines, joints of their tarsi also furnished with apical spines; entire surface bristly, especially at apex of intermediate and anterior tibiæ.

Wings varying in size from rudimentary to fully developed; the anterior pair slightly dusky, posterior pair hyaline; in fully developed wing the cilia on costal border of each pair is short and sparse, on posterior border longer but not very heavy; venation of anterior wings rather weak; anterior and posterior basal cross veins present, but not distinct; costal vein furnished with 18–21 spines; cubitus, 10; radius, 10–11; anal, 5; anal cell, 1; spines on cubitus are arranged in a basal group of seven, followed by three more widely separated on distal end of vein; longitudinal vein of posterior wings incrassate at base, not quite attaining tip of wing.

Color usually pale yellow, deeper on thorax and legs, the latter frequently dusky; head and proximal joints of antennæ white, intermediate joints brownish-black at base, the rest of the antennæ deep black; occiput often tinged with yellow, sometimes dusky; eyes dark red-drown; ocelli yellow, inner margins brick-red; prothorax at margins, disc of mesonotum, pleuræ, except upper portion of mesopleuræ in front, narrow medium stripe on scutellum, pale; two spots or patches on prothorax, sometimes diffuse and coalescing sometimes nearly or quite obsolete, two broad, approximate stripes on scutellum, diverging slightly and extending outward and backward in a broken and interrupted line to lateral margin, upper portion of mesopleuræ in front, brown; abdomen somewhat dusky, more or less pale at sides and toward apex; narrow basal band on segments 2-7, expanding laterally and broken up into spots, one of which is more conspicuous than the others, brown.

Femora and tibiæ dusky or brownish on upper surface, pale on lower surface and at base, the latter also pale at tip; anterior wings dusky yellowish; spines brown.

By its seven-jointed antennæ. *T. lactucæ* is allied to *T. tabaci*, Lind., but it is more heavily marked with brown; the color of the intermediate joints of the antennæ is darker; the antennæ and the ocelli more approximate: the ocelli more conspicuous and farther removed from the anterior margin of the vertex; the prothoracic bristles larger and less uniformly distributed, being entirely absent from two discal areas; those at posterior angles, longer; proximal spines on cubitus arranged in a single group.

Described from numerous specimens taken on wild lettuce in October, November and March, at Ames, Iowa.

T. lactucæ bears some resemblance to *T. tritici* in size and general color, from which it may be easily separated by the fewer antennal joints, less rectangular head, less widely separated ocelli, absence of long bristles at anterior angles of prothorax, less numerous cubital spines and their arrangement in groups, absence of spines at apex of intermediate and anterior tibiæ and inner margin of posterior tibiæ.

From *T. striata* it may be known by the difference in number of antennal joints, absence of annulation on sixth joint, presence of longer and more numerous spines and bristles.

Thrips pallida n. sp.

Female: Length 1.12 mm. Color varying from white to pale yellow. Antennæ, beyond basal joints, more or less dusky. Head small, eyes large. Anterior wings partially trifasciate. Bristles on anterior portion of body long and slender. Prothorax characterized by the presence of a long bristle on the middle of each lateral margin in addition to those at anterior and posterior angles.

Head small, about as long as broad Occiput very short, not more than one-third the length of the head. Eyes dark red-brown, very large and prominent, sparsely and feebly pilose. Vertex narrow, elevated, transversely convex, ascending toward the anterior margin, the latter arcuate. Ocelli in middle of vertex, nearly colorless, their inner margins white, contiguous anteriorly. Ocellar bristles as long as the head. Front prominent, bearing a row of recurved bristles above insertion of antennæ. Mouth parts short, nearly symmetrical.

Antennæ approximate; the two basal joints the stoutest; joint 1 semiglobose, one-half the length of joint 2; the latter is stouter than the former, barrel-shaped, equal in length to joint 5, and a little shorter than joints 3 or 4; these are robust, subequal in length and broadly obovate, the pedicel of joint 3 is short and slender; joint 5 is oval and less robust than the two immediately preceding; the remaining joints are sessile, together form an elongate oval; joint 6 is longer than any other joint; joints 7 and 8 are short and of equal length, base of former narrower than apex of 6; apex of 8 is lanceolate. Bristles and hairs are of equal size, and arranged much as in *T. tritici.* The long sensorial spine on outer side of joint 6 originates below the middle of the joint.

The prothorax is convex; its sides converge cephalad; its surface is nearly smooth, with a double median transverse groove or double impressed line and a few short and several long slender bristles, the latter arranged as follows: one at each anterior angle, two on intervening space of anterior border, one at middle of each side, one near and two at each posterior angle. The mesoscutum is longitudinally convex, its surface nearly smooth, furnished with two lateral bristles directed inward, and two smaller ones on disc and on posterior border, respectively. The scutellum is subrectangular, obtusely carinated, descending toward the apex; on basal margin provided with two distinct bristles which extend nearly to apex.

The abdomen is slender at base, ovate, with few conspicuous bristles; those at apex of ultimate segment much shorter and weaker than those on preceding segment.

Legs are moderately stout, bristly; anterior femora incrassate, their tibiæ stout; spines present at apex of posterior tibial and tarsal joints, on inner margin of tibiæ replaced by bristles.

The anterior wings are whitish, slender, rather thin, subfasciate with three dusky spots; the first near base of anal area, the other two dividing the remainder of the wing into three subequal parts; sometimes a faint spot may be detected near apex of wing; these spots are variable in distinctness and may be obsolete; ciliæ of inner margin, light; of outer margin, sparse and scarcely longer than the spines with which they are interspersed. Radial vein is obsolete between base of wing and posterior basal cross vein, consequently it appears to originate in the cubitus. Both radius and cubitus terminate abruptly before attaining marginal vein. Cross veins connecting costal and cubital veins are obsolete. The costal vein bears from 15-20 spines: the cubital, 10; radial, 5; anal, 4, and posterior marginal vein 1, placed opposite the posterior basal cross vein. The posterior wings are hyaline; proximal end of longitudinal vein incrassate.

Male. Length .97 mm. Smaller than the female, but very similar in distinctive characters. Apex of abdomen is bluntly conical, less truncate than in male of *T. tritici*, partially trilobate, the lateral lobes are very narrow, shorter than the middle lobe, and terminate in a single long bristle. Penultimate segment terminates in a row of short sparse bristles, on dorsum, and single long spine on each side.

Described from ten females and seven males. Taken on bean and elm at Ames, Iowa; on blackberry at Belle Plaine, Iowa, and on hop at Barraboo, Wis.

Thrips pallida is a well marked species and is readily separated from the other species included in this paper by the small head, the presence of a bristle on middle of lateral margin of prothorax, the feeble armature of inner margin of posterior tibiæ and the number of spines on the front wings.

NOTE ON A NEW SPECIES OF PHLŒOTHRIPS, WITH DESCRIPTION.

HERBERT OSBORN.

In connection with the paper by Miss Beach on the Thripidæ it seems desirable to describe a species which has for a long time been in our collections, but has not received a technical description.

Phlœothrips verbasci, n. sp. Black, polished; head quadrate with a prominent post-ocular bristle: prothorax widened behind; first joint of anterior tarsi armed on inner side with a curved tooth.

Female: Head quadrate, very slightly constricted behind, a prominent bristle behind the eye; antennæ light yellowish with dusky base and tip, joints 1 and 2 black, 3–6 yellow, 7–8 dusky, ending with two bristles; prothorax widening behind, with prominent angles, three lateral bristles; meso and meta-thorax subquadrate. Legs black except anterior tibiæ and all tarsi which are yellow, the tarsi somewhat clouded with dusky. Anterior tarsi with a short curved tooth on inner side of first joint at middle. Wings hyaline except base of anterior pair, which is fuliginous; anterior pair with no fringe at base; anal vein entire; median vein distinct at base, but becoming obsolete; three long spines in a row on the inner side of the median vein near base: posterior wings at base with two long, slender bristles near together on hind margin; abdomen at apex with six long and seven short bristles; tube reticulate.

Male smaller than female and having two slender spines on a slight elevation at side of the anterior margin of the first segment of the abdomen.

Length of male 1.50–1.60 mm., female 1.80–1.90 mm.

This species stands near to *nigra*, Osb., but differs decidedly from that species in the more quadrate head, prominent posterior angles of the prothorax, as also in the presence of two prominent bristles just behind the eyes and the different number and character of bristles at apex of tube.

It occurs almost invariably in mullein, hibernating in the stools, and may be found in early spring at the base of the fresh leaves, especially among the dense interior leaves. The whitish, cylindrical eggs are deposited during April, and larvæ develop on the mullein leaves. The larvæ differ decidedly from the larvæ of *nigra*, in being yellow or orange instead of deep red.

Adults, bred forms of which matured June 20th to 26th, are found in mullein blossoms in midsummer (July), and probably produce a second brood. Adults have been taken in September in the seed pods, and in November at the base of dead mullein stalks.

This is the species referred to in my article on "The Food Habits of the Thripidæ" (Insect Life, Vol. I, p. 141) as *Phlœothrips sp.*, the species being cited in evidence of an herbivorous diet for the *Thripidæ*.

Compliments of the Authors

CONTRIBUTIONS FROM THE
DEPARTMENT OF

ZOOLOGY AND ENTOMOLOGY

Iowa State College of Agriculture
...AND...
Mechanic Arts.

NUMBER 2.

Contributions to the Hemipterous Fauna of Iowa. Herbert Osborn and E. D. Ball.
Notes on the Orthopterous Fauna of Iowa. E. D. Ball.

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Contributions from the
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CONTRIBUTIONS TO THE HEMIPTEROUS FAUNA OF IOWA.

BY HERBERT OSBORN AND E. D. BALL.

I. ON THE LIFE-HISTORY OF JASSIDÆ.

(With descriptions of new species and a review of the genus Deltocephalus.)

In various papers published during the past five years the senior author has called attention to the injuries caused in grass lands and pastures by the numerous species of Jassidæ, which swarm, often by millions to the acre, upon various species of grasses.

In these papers it has been shown that the loss, though seldom noticed, must be really enormous, and that by the use of the tar pan or "hopper-dozer" the insects may be to a great extent destroyed. Further than this, however, our knowledge has been too meager to furnish a certain basis for remedial measures. It is true studies were made of a few species and some facts learned as to their life-history which warranted the belief that burning, mowing, etc., might be of service, but still so much remained unknown regarding even the most common species, that there seemed a necessity for a more exhaustive study. At the beginning of the present season (1896) a study was planned, the essential features of which were: First, a determination of the life histories of as many as possible of the species known to feed upon grasses. Second, the determination of the range of the food plants for each species, especially in the larval stages. Third, the collection of all species occurring on grasses and their careful identification with a close study of the specific limits of each, as a basis for further life history studies.

Any facts suggestive of successful treatment have been carefully noted, and suggestions as to treatment of individual species made, but it has been deemed essential in this study to hold in reserve general conclusions as to treatment and to gather, first, all facts possible bearing on the life and habits of the species. These will undoubtedly furnish a scientific basis for economic treatment.

Insectary studies have consisted in rearing, as far as possible, all species in breeding cages, consisting of glass globes or netted frames over grass in large pots, along with continuous field study, the one as check to the other. In the investigation some sixty species have come under observation as grass feeders, not to mention some sixty more referred to other food plants, and their study has involved the examination of many thousands of individuals in all stages.

Of a number of species we are able to present sufficient details of life history to warrant positive conclusions, while of others the record is yet too fragmentary to be more than a starting point for future work.

While this study was undertaken primarily with reference to its economic aspects, and this phase has been dealt with particularly in a paper, duplicating this in part, to be published in bulletin 34 of the Iowa experiment station, so much matter of a technical nature has been accumulated which seems of importance in the systematic study of this group that it has been deemed desirable to publish it, with full technical descriptions of new species, where it will reach students of systematic entomology, and those interested in the biological questions discussed.

We have as a basis for work in this group, aside from the large mass of material collected in Iowa, types of all the Homoptera described by Mr. E. P. VanDuzee as well as the entire collection of Hemiptera which he made, and which formed the basis for his numerous contributions to American Hemipterology.

The college collections contain, further, a large amount of material in Hemiptera from Colorado, South Carolina and Georgia collected by Morrison; from New Mexico, Arizona, California and the northwest, collected by Wickham; from Mexico, collected by Osborn and Townsend, besides numerous smaller series received in exchange or for determination. Also series of European species, embracing representatives of a large proportion of the genera. Also some exotic material from the Bahamas, West Indies, etc.

The plates are photo-reproductions of drawings made by Miss Charlotte M. King, under personal direction and supervision of the authors.

It has not been our purpose to prepare a full list of species, but only to include such as we have studied We have followed in arrangement, however, the "Catalogue of Jassoidea," by Mr. E. P. VanDuzee, and that catalogue may be consulted for additional references, synonomy and bibliography.

Types of the new species are deposited in the National museum.

Some of the results which seem to be general in nature may be mentioned here.

The species of Jassidæ have, as a rule, a decided limitation as to food plant, usually holding closely to one species of plant, almost invariably limited to one plant for breeding, but feeding more indiscriminately in maturer stages.

So far as known, all the species deposit eggs upon the stems under the leaf sheaths or in the leaves of the plants used as food.

There is a wide difference in life-histories, some having one brood, the majority of the grass-feeding species two, and still others three in a season, and the successive stages occurring at widely different times.

Except in the case of adult hibernation the ordinary life of a brood of adults does not exceed two months, and for the individuals of a brood rarely over one. The males appear a week to ten days before the females and disappear as much earlier. In general, one brood of adults will have disappeared before the larvæ of the next have matured, so that individuals collected at any time may be referred with assurance to a particular brood.

It follows also that eggs for each brood are deposited within a limited time and that a period may be defined during which all eggs of a given brood for a given species will have been deposited, and during which time measures for their destruction may be applied.

Observations were made to ascertain whether simply cutting the grass and leaving it in the field would prevent hatching, and in no case were eggs observed to hatch from stems cut green. Part of the stems from a plant in which eggs were fully developed were cut and left to dry. The second day after the eggs hatched in the uncut stems but no larvæ issued from those that were cut and, on examination, the eggs were found to be crushed and distorted from the shrinking of the plant tissues and by the curling of the edges of the sheaths in drying. Even if hatched they would have been unable to escape from the rigid incurved edge.

It has been learned that the larvæ present definite characters which are of specific, and in some cases generic, value. These, along with what prove to be constant characters in large series of adults, enable us to combine some forms hitherto considered as distinct species, and also to separate as distinct some forms hitherto included with other known species.

Colorational characters in certain genera are of very little value, since it is found that summer broods and species occurring in shaded localities are pallid or unicolorous, while autumn broods or exposed individuals assume darker and more definite markings, often varying to black.

Another feature of considerable interest and of value in the discrimination of species is presented in the fact that for a number of species there are distinct long and short winged forms with consequent variations in venation (usually given generic importance) the long winged condition apparently associated with a migrant habit.

The grasses which have been more particularly under observation during the season and which seem to have each its particular jassid fauna, are: Blue grass (*Poa pratensis*), *Andropogon scoparius* and *provincialis*, *Elymus canadensis* and *virginicus*, *Bouteloa hirsuta* and *cutipendula*, *Stipa spartea*, *Spartina cynosuroides*, *Sporobolus hockeri*, *heterolepis*, *asper* and *cryptandrus*, *Chrysopogon nutans*, *Muhlenbergia racemosa*, *diffusa* and *sylvatica*, *Bromus ciliatus* and *purgans*; also a number of annuals, especially the *Panicums* and *Setarias*.

A statement of the known host plants accompanies the discussion of each species.

TETTIGONIA BIFIDA SAY.

Journal Acad. Nat. Sci., Phila., IV, p. 313, 1831; Comp. Writings II, p. 387, 1869.

This is a rather handsome little species, and its range of food habit seems to be more restricted than many of the others, it being found only on blue grass in shady places. The latter restriction confines it to wooded pastures, where it is perhaps almost as common though less universal than *inimicus* in open pastures.

The adult is about six millimeters long, of greenish color, with circular alternate bands of black and white on the head and pronotum parallel to the border. The wings have seven black stripes, the outer one forking near the middle.

Adults are first recorded for July 11th, and were most abundant July 14th, becoming gradually less numerous till the first of September, when they disappeared. While egg deposition must occur during July or August it has not been observed.

The larvæ observed July 2nd to 20th were about half the length of the adults, fully as broad, with the surface of the body of a powdery white appearance. The head is large, broad and deep, much inflated, almost round in front; eyes dark; wing pads broad and short; the abdomen inclined to be carinate dorsally.

They are decidedly different from the larvæ of any other species of *Tettigonia* studied in the much shorter body, a fact which would seem to indicate separation from the normal *Tettigonia* forms, and which allies them to *Euacanthus.*

While ordinarily considered a rather rare species this certainly occurs during a part of the year in its particular haunts in great numbers—that is in the rather rank blue grass of timber areas. In such locations it has been estimated to occur at the rate of 50,000 per acre.

DIEDROCEPHALA MOLLIPES SAY.

Tettigonia mollipes Say. Jour Acad. Nat. Sci., Phila., IV, p. 312, 1831. Comp. writings II, p. 386. *Aulacizes mollipes* Fitch. Homop N. Y. State Cab., p. 56, 1851. *Diedrocephala mollipes* Walker. Homop. Suppl., p. 233, 1858.

This species has been observed heretofore, and a record of two broods a year indicated. Observations this year show a somewhat later appearance of the spring brood, larvæ occurring through June and first week in July, adults appearing the last week in June, continuing through July, and to about the 20th of August. The second brood of larvæ appeared about the second week in August, running through September and maturing in October and November. First adults of second brood appeared about September 15th and continued through the season. Hibernation seems to occur in all stages, considerable irregularity being shown, but the main body being adapted to the hibernation of eggs.

The range of food plants is large, there seeming to be little choice between annual or perennial grasses. It has been recorded from *Adropogon scoparius* and *provincialis*, *Panicum crus-galli*, *scoparium: Setaria viridis* and *glauca.* Wheat, oats, barley (especially volunteer growth), slough grass (*Spartina cynosuroides*), wild rye, (*Elymus canadensis*). It occurs less commonly on blue grass, probably in most cases only when other grasses are present.

As egg deposition in autumn is almost entirely confined to large-stemmed grasses, the destruction of these in pastures is advisable.

DIEDROCEPHALA NOVÆBORACENSIS FITCH.

Aulacizes novæboracensis Fitch. Homop. N. Y. State Cab., p. 56, 1851.

This is a larger and lighter colored species than *mollipes*, and may be further distinguished by the blunter head and the two black spots at the tip. It has been found to occur only in sloughs or in heavy grass adjacent to them, especially slough grass (*Spartina cynosuroides*).

The adults were taken through the last of June and through July, and again from the middle of August through September. It seems to be decidedly limited in its range of food plant, and would be of little economic importance except where slough grass is used for hay.

DIEDROCEPHALA COCCINEA FORST.

Cicada coccinea Forst. Nov. Species Ins., p. 96, 1781.

This is the brightest colored species of the genus occurring at Ames, and is intermediate in size between *mollipes* and *novæboracensis.*

The vertex and scutellum are bright yellow. The pronotum is variously marked with green, red and yellow. The elytra are bluish-green, with two broad purple stripes, and a narrow yellow margin. Below, all yellow, except a narrow black line just under the vertex. Length, nine to ten mm. Readily separated from *versuta* by the absence of dark markings on the vertex, and the larger size.

The larvæ are of a pale yellow color throughout. Head much inflated, convexly pointed, resembling that of adult but larger; thorax broad, abdomen long and slender. The pupæ are still lighter colored, and have a scarlet mark on each wing pad.

This species is two-brooded. The larvæ were taken nearly full grown about the 1st of June. Adults were taken from about the middle of June through July, and again through September and October.

They were taken from woody regions, but usually swept from the undergrowth of grass and weeds. Adults of the second brood were taken from coarse grasses long after the trees had shed their leaves.

XEROPHLOEA VIRIDIS, FABR.

(Pl. xix, Fig. 1.)

This grotesque species occurs throughout the entire United States at least. Van Duzee reports it from New York to Florida, Texas, Colorado, and California. In addition to this, specimens are at hand from Oregon, Utah, Arizona and Nebraska, and it has been collected at Ames rather commonly.

The adults are six or seven millimeters long by two millimeters wide across the pronotum; the head is slightly narrower than the pronotum; eyes small; vertex flat, produced and roundingly angled in front, anterior margin very thin. The elytra are long and angularly pointed behind, the claval area is nearly flat while the corium is strongly deflected, becoming perpendicular at the tip, giving the insect a wedge-shaped appearance. The entire dorsal surface is coarsely pitted. The females are bright green with the tips of elytra lighter, sometimes clouded or minutely dotted with darker along the margins; the males have in addition a broad median smoky line on the vertex and an irregular transverse dark band on the pronotum more or less strongly margined with lighter before.

Genitalia: The last ventral segment of the female is divided medially to its base and consists of two long, roundingly pointed lobes; male valve broadly, obtusely rounding, length and breadth about equal; plates narrow, spatulate, two and one-half times the length of the valve.

Larvæ: Similar in form to the adult but with a broader body and longer head; vertex one-half longer than wide, acutely angled before, margin very thin, whole depth of head less than one-fourth the length of the vertex; abdomen short, dorsally carinate; color green, the entire surface covered with short white hairs arising from minute black spots; a pair of larger black spots near the base of the wing pads and another pair on the posterior margin near the inner angle.

Larvæ were found nearly full grown in August; the adults were taken from the second week in August until October. They were swept from a native grass pasture where they were fairly abundant. Specimens from Nebraska and Utah bear dates from May to July, indicating that the species is two-brooded. Observations were not made upon the field where it occurred during the first half of the season, which would account for its not being found sooner.

This species agrees in every particular with Burmeister's description and figure of *grisea* Germar, from Brazil, and undoubtedly it should be placed as a synonym of that species. But Fabricius' description of *viridis* from "Americæ insulis" precedes both, and though brief, agrees well with them and probably characterizes the same species, at least so far as we know no other species which could answer their description occurs.* If this is correct the synonym will stand.

Xerophloea viridis Fab.

Cercopis viridis, Fab. Ent. Syst. IV 50, 13, 1794.
Xerophloea grisea, Germar Zeits. F. G. Entom. I, 190, 1, 1839.
Xerophloea virescens, Stal. Ofv. Vet. Ak. Forh., 1854, p. 94, 30.
Xerophloea viridis, Fabr., Stal. Hemiptera Fabriciana, II, p. 59.
Parapholis peltata, Uhler Bull. U. S. Geol. and Geog. Surv., III, p. 461, 1877.
Xerophloea peltata, Uhler Stand. Nat. Hist., II, p. 248. 1884.

Professor Uhler, in the Standard Natural History (vol. II, p. 248) gives the range of the species as from Massachusetts to Rio Janeiro in Brazil, thus covering the territory indicated by the three descriptions.

GYPONA GERMAR.

Although the *Gyponas* have never been recorded as grass-feeding species the observations this season show that for one of them at least this is an exclusive habit, and for others apparently a normal one.

The species are widely variable in color and size, and the genus needs a thorough revision in order to reduce to consistent species the long list of so-called species which has arisen from the characterization of these numerous varieties.

Structurally the species are very constant and present definite characters in the shape of the head, the venation and the genitalia.

GYPONA OCTO-LINEATA SAY.

Tettigonia octo-lineata Say Comp. Writ, II, 257.
Gypona striata Burmeister, Gen. Ins. Gen. 16, No. 9.
Gypona flavilineata Fitch, Homop N. Y., State Cab., p. 57.
Gypona quebecensis Provancher, Nat. Canad. IV, 352.
Gypona cana Burm, Gen. Ins., Pl. 16, No. 10.
Gypona flavilineata, Spangberg, Spec. Gyponæ, p. 8.

This is the longest and one of the narrowest species in the genus, on account of its long, narrow elytra, much exceeding the abdomen. It varies in size from large females eleven or twelve mm. long by three mm. wide down to the smallest males only seven or eight mm. long by two mm. wide. The vertex is two-thirds as long on the middle as the width between the eyes, front margin very thin, roundingly produced. Ocelli small, slightly behind the middle of the vertex; elytra long and narrowed to a blunt point behind. The venation is indefinite, consisting of fine reticulations on the apical half, and sometimes including the whole surface except the base of the costa.

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* A series of thirteen specimens of this insect from Cuba, kindly sent by Mr. Robert Combs, shows most perfect agreement with Iowa specimens, and no other species of the genus is represented in his collecting.

Genitalia: Ultimate ventral segment of the female moderately long, nearly truncate behind, curved downward in the middle, giving it an emarginate appearance, the edge often thin and membranous. The last ventral segment of the male longer than the pronotum, truncate, concealing the valve. Plates narrow, ligulate, nearly four times longer than wide, longer than the last ventral segment, nearly equaling the pygofers, separated at the base by one-half their width, obliquely overlapping at tip. Pygofers broad at base, obliquely truncate from below, tips produced incurved and touching each other.

Color very variable, early specimens of both broods, especially of the first, light green, the yellow lines indistinct; elytra nearly hyaline, nervures weak. This form is the *flavilineata* Fitch, and *striata* Burmeister. Late specimens of the first brood and nearly all of the second are dark green with the elytra strongly reticulate. The yellow lines may be strongly marked or almost wanting; these include the forms described as *quebecensis* Prov., *cana*, Burmeister and *flavilineata* Spangberg. Specimens collected during the latter part of September and throughout October were more or less tinged with red, especially in the females. Specimens being taken which varied from the lines red, through forms that had the lines and the elytral reticulations red, to females that were almost entirely scarlet dorsally, these last being the typical *octolineata* form.

Throughout the whole series the structural characters, with the exception of the strength and number of the reticulations, scarcely varied.

These conclusions are based on the examination of hundreds of specimens showing the most complete intergradations in all these variations. In accord with the general rule for jassids, the first brood, mostly *flavilineata* form, are weakly veined, and those of the second brood, mostly *octolineata* form, are strongly veined and more highly colored.

Larvæ are very broad and depressed, more so than the adult, which it much resembles. The vertex is abruptly narrowed in front of the eyes, then strongly projecting with parallel margins and a broadly rounding apex, the whole projection extremely thin, antennæ nearly as long as body, basal joint as long as vertex, abdomen long and compressed; general color green.

The pupæ are broader, shorter, darker green than the larvæ, and have two fuscous spots on the inner angle of the wing pads.

Larvæ were found June 16th, small to half grown, continuing abundant until the middle of July. Adults appeared about the first of July, continuing till the middle of August. Second brood larvæ occurred into the latter part of August, and on through September. Adults appeared in September and October.

This is by far the most abundant species of the genus, and occurs throughout the entire region east of the Rocky mountains from Canada to Texas, at least, and is closely related to the South American *lineata* of Burmeister, if not identical with it.

In common with other jassids which have a wide distribution, it does not seem to be confined to any particular food plant, but may be found almost everywhere, preferring rank growths in shaded situations. It is the only representative of the reticulated elytral group occurring at Ames, and is unique in that it is two-brooded, while the other species are all apparently only single-brooded.

GYPONA BIPUNCTULATA WOOD.

Gypona bipunctulata, Woodworth, Bull. Ill. State Lab. Nat. Hist., III, p. 30, 1887. (♀)
Gypona nigra, Woodworth, Bull. Ill. State Lab. Nat. Hist., III, p. 31, 1887. (♂)

This is the largest jassid known to occur on grasses in Iowa, and presents a very marked difference between the males and females. The females described as bipunctulata by Woodworth are bright green, stout, deep-bodied. The vertex is short, ocelli small, and there are distinct black dots on the pronotum, one each side about half way from the middle to the margin; also a distinct dot on the base of each elytron just under the outer angle of the pronotum.

The male, which was described as *Gypona nigra* by Woodworth, has the head and pronotum black, margined with light green. The black color nearly conceals the dots of female pronotum. The elytra are hyaline and allow the black tergum to show through, so in most specimens there is usually a quite uniform dark color to the whole upper surface except the margin. The genital plates are broad, shorter than sixth segment, truncate at apex.

Woodworth described this species from Illinois, and we have specimens from Kansas aside from numerous examples taken in Iowa.

The adults appear the middle of July, the males about a week before the females, and continue to the latter part of September. They have been taken only from grasses.

Full-grown larvæ were swept from prairie grass July 6th. They are shorter, stouter, with shorter vertex, covered all over with stiff white hairs.

In addition to these a small larva was taken from the base of an *Elymus* stock, September 5th, and another larger one May 22d. This pupated in cage May 29th and died June 16th. These two larvæ are doubtfully referred to this species which, if correct, would indicate *Elymus* as the larval food plant.

EUACANTHUS ACUMINATUS FAB.

(Pl. xix, Fig. 3.)

Cicada acuminata, Fab. Syst. Ent. IV, 36, 40, 1794.
Euacanthus orbitalis, Fitch. Homop. N. Y. State Cab., p. 57.

Fitch's description of *orbitalis* and the specimens at hand agree in every respect with the description of *acuminatus* and with European examples of the species, so that there seems to be no question as to their specific identity.

This species occurs throughout the whole of central Europe, and probably has an equally general distribution in this country. It has already been reported from Canada, New York and Michigan, and specimens are at hand from Washington, D. C., and Vancouver's Island, besides adults and larvæ taken at Ames this season.

The adult is very stout-bodied with a broad vertex and small round eyes. Length, 6 mm., width on center of costa, 2mm.

Vertex about equaling pronotum in length; nearly twice broader than long, obtusely angled anteriorly, medially and laterally carinate; ocelli on the vertex near the carinate anterior margin, about equally distant from eye and tip; front broad above, rounding to the small clypeus; base of the antennæ overhung; pronotum short; elytral venation simple, first sector only once forked; color, shining black with margin of eyes, tip of vertex, elytral nervures and a large spot near the base of the costa, white.

Genitalia: Ultimate ventral segment of the female long, rounding, posterior margin arcuated and slightly notched. Male valve obtuse, short; plate long and very narrow, exceeding the pygofers.

Larvæ white: Head similar in form to the adult, much more inflated and produced, one-third the length and nearly half the size of the whole insect, four times the length of the bead-like eyes, evenly and finely covered with short white hairs; antennæ extending beyond the middle of the abdomen; thorax narrower than the prominent eyes; abdomen slender, dorsally carinate, tipped with coarse white spines; entire body covered with fine white pubescence; thorax and abdomen sparsely set with curved black hairs pointing backward. Length of full-grown larvæ 5.50 mm.

Larvæ and adults were taken the first week in July; adults continuing to be found throughout the month. Swept from a woody pasture in which numerous *compositæ* abounded. Larvæ in cages fed indiscriminately on a variety of plants taken from similar situations.

Although not hitherto recorded specimens of the other European species, *Euacanthus interruptus* L., have been represented in American collections but have been placed with Fitch's *orbitalis.* Those at hand are from South Carolina, but it doubtless has much the same distribution as *acuminatus* here, as it does in Europe.

The position of the ocelli in this genus is strongly suggestive of the *Acocephalinæ*, while in some other respects it appears to be more closely related to the *Tettigoninæ.* This and the following genus, which seem very closely allied, may very probably represent generalized or intermediate forms connecting the two sub families.

NEOCOELIDIA TUMIDIFRONS G. & B.

Hemiptera of Colorado, p. 101.

The male of this species was described in "Hemiptera of Colorado," page 101. The female taken at Ames this season differs considerably from the male description, and may be characterized as follows:

FEMALE.—General aspect of *Euacanthus;* light yellowish green above, no dark markings visible on the scutellum. Below, yellowish-green with rostrum, oviduct and spines on legs orange. Vertex furrowed and nearly parallel margined next the eye as in *Euacanthus*, but lacking the carinæ, then convexly conically rounding to the front; length on middle twice that next the eyes, width between eyes equaling length. Ocelli small, on the rounding margin of vertex as in *Nestocephalus*, about one-third the distance from the eye to tip. Front at ocelli one-half wider than at loræ. Antennæ inserted beneath a ledge, nearly as long as body; first and second joints large; pronotum very short on the middle, continuing broadly behind the eye and around back of the genæ as in *Euacanthus.* Elytra about equaling the abdomen; spines on the hind tibiæ very strong, a crown of short spines on the tip of the tibia, and the first two tarsal segments.

Genitalia.—Ultimate ventral segment of female nearly as long as width at base, elevated in the middle; posterior margin truncate, with a broad median notch; pygofers narrow, moderately exceeded by the oviduct; the margins and tip studded with short, stout, orange spines; length, 4.50 mm.; width on center of costa, nearly 2 mm.

Larvæ.—Half-grown specimens taken the middle of September already possessed the characteristic head and pronotum of the adult. The antennæ were longer than the body, basal joints very large, and arising from under a well marked ledge; color, bright green, with six black spots, as follows: A pair of round ones occupying the anterior half of the eyes, a pair on base, and another on posterior margin of the wing pads, directly behind and in line with the eyes, anterior pair partly concealed by the pronotum. Spines on the genitalia, and legs stronger than in the adult.

This species was taken in upland pastures in which *Andropogon scoparius*, *Bouteloa hirsuta* and *curtipendula* predominated. Adults were taken the latter half of August; half-grown larvæ were found September 13th and 17th.

This is a very peculiar species, and suggests a relationship between *Euacanthus* and *Xestocephalus*, two of the lower genera, placed respectively in the sub-families *Jassinæ* and *Tettigoninæ*.

XESTOCEPHALUS PULICARIUS VAN D.

Bull. Buffalo Soc. Nat.. Sci. vol. IV, 1894.

This is a narrow, convexly conical headed little species with broad maculate elytra and a brown vertex marked much as in *Tettigonia hieroglyphica*. Length about 3 mm.

This species might easily be mistaken for a *Deltocephalus* but for the ocelli which are situated nearly half way from the eyes to tip of vertex. It was found rather commonly on blue grass in shaded locations through July and August.

Very generally distributed north, and specimens have been received from Mississippi (Weed).

XESTOCEPHALUS CORONATUS N. SP.

(Pl. xix, Fig. 2.)

Form and size of *pulicarius* nearly, but with head and pronotum shining black, with white markings; length, female, 3 mm.; male, hardly 2.50 mm.

FEMALE. Head nearly equaling pronotum in width; vertex two-thirds the length of the pronotum, one-half longer on middle than next eye; width at base nearly twice the length, convexly rounding to the front; lateral and posterior margins, a median stripe extending forward across the disk, and ocelli white; tip white, broadly margined with orange. A broad lateral margin approaching so near the ocelli as almost to complete the white margin and reduce the black to a large spot on either side of the median line of the disk. Front narrow at ocelli, widening to antennal pits, then rapidly narrowing to the clypeus; light orange above, shading to black below; clypeus and loræ black; genæ broad, white; antennæ long, arising from under a distinct ledge; pronotum short, margins nearly parallel, black, with a transverse white band just before the posterior margin; scutellum, basal half black, with a narrow median stripe, apical half orange. Elytra maculate with black as follows: The middle and tip of clavus, apex of elytra, a small spot on the costa before the apex, a broad, slightly oblique band arising beyond the middle of the costa and extending to the clavus, branching before the middle and running narrowly to the anal cell and a smaller curved band near the base of the costa, sometimes uniting with a median one near the claval suture.

MALE. Vertex without the median stripe or orange marking; upper part of front and all the vertex within the white margin, shining black, except ocelli and a point on the tip equaling them in size, white; lower part of front and clypeus orange.

GENITALIA. Ultimate ventral segment of female very broad, posterior margin straight, roundingly notched in the center, slightly deeper than in *pulicarius*. Male valve short, obtusely concavely pointed; plates inflated, broad at base, concave, narrowing to an acute apex; apex curved upwards around the pygofers which, together with the plates, are margined with plumose white hairs.

Two males and one female of this very distinct little species were taken from a deeply shaded patch of bluegrass in August. Ames, Iowa.

THE SHOVEL-NOSED LEAF-HOPPER.

DORYCEPHALUS PLATYRHYNCHUS, OSB.

(Pl. xx, Fig. 1.)

Canadian Entomologist, XXVI, p. 216, 1894.

This very peculiar insect has hitherto been recorded only from Ames, Iowa, and West Point, Neb., and has been considered very rare, only three or four specimens in all having been seen prior to the present season. Nothing was known as to its life history or food habit. During the present season, however, it has been found in large numbers, and since it has bred freely in the breeding cage, it has been possible to determine its full life-history.

At first sight one would infer that it would be a very conspicuous object, an easy victim for natural enemies or the obtrusive collector. As a matter of fact this proves to be only a remarkable adaptation to its food plant (*Elymus*) in color, form and life-history.

The linear aspect and dark dorsal stripe, more or less broken or obscured, harmonize so well with the ordinary rusty *Elymus* stem to which it closely adheres and from which it can scarcely be driven, either in larval or adult stage, that it is detected with great difficulty. They rely on this mimicry for protection rather than upon flight or leaping. So perfect is this protection that one may look for some time at a few stems of grass where dozens of the insects are known to occur and fail to locate them.

The figure shows the distinctive features sufficiently and a full description is unnecessary here, but it may be proper to call attention to the fact that there are two forms of females, one having the elytra very short (wings proper rudimentary), as figured, the other with much longer wings and smaller body and more pointed rostrum, more closely resembling male. This flies readily while the other is entirely incapable of flight and never leaves the plant on which it is hatched. The males are all long-winged.

It is single brooded, the adults appearing about the middle of May and continuing in decreasing numbers until the end of July. During the last week in May and the first week in June the eggs are deposited; the female selects a spot about two inches above the base of the first or second leaf from the bottom; having selected the spot apparently with much care, she takes her position head upwards, legs placed close together and tarsi clasping the stem; then, raising the body the length of her legs and curving the abdomen upward, she unsheathes the ovipositor from the pygofers and brings its tip down against the grass stalk, pointing backward slightly from the perpendicular; she then moves slowly around the stem keeping the body parallel with it and the guides pressed firmly against it until they catch under the edge of the encircling leaf sheath; having done this they are gradually forced under the sheath, usually extending almost half way round the stem. As they are gradually forced in the abdomen straightens and then hollows until, when the ovipositor is fully inserted, the abdomen is curved down and the pygofers are pointed upward and backward at more than a right angle with the guides. Having reached this position she works slowly backwards, opening the sheath downward with a peculiar sawing motion alternating with a slight pause for the deposition of an egg.

The eggs are one and one-half millimeters by one-third millimeter, cylindrical, gradually tapering from a point near the head back to an obtusely rounded tip; the anterior end is cut off obliquely from one side and rounded from the other, coming to an obtuse point. They are deposited in a continuous row, from thirty to fifty, side by side, curving slightly around the stem with their heads toward the edge of the sheath, from which they are distant about one-third the circumference. The time occupied in actual deposition is from twenty to forty minutes, but the selection of a location and the catching of the sheath edge often occupies several hours.

Although the eggs were deposited through a period of two weeks or more they apparently all hatched at about the same time; the time evidently depending considerably upon favorable conditions of temperature and moisture, for, up to July 2d, no larvæ had been observed either in the cages or in the field. On this afternoon the air was very oppressive, and remained so until cleared by a heavy thunder storm during the following night. On the morning of the 3rd they were observed just emerging from the eggs in the cage, and examinations showed that they had hatched in the field also. The earliest deposition from which they were observed to issue on this date was made May 25th, and the latest on June 9th, while the majority were deposited June 4th and 5th. This gives from twenty-six to thirty-eight days, with an average of about one month, as the period of incubation.

The freshly hatched larvæ have shorter and blunter heads than the adults, and are much more active, but within a week or two the head has elongated, and it has adopted the sluggish habit of the adult.

Upon hatching, the larvæ immediately arrange themselves along the base and margins of the broad leaves parallel to the veins, where they remain stationary for weeks at a time, so closely resembling the rust spots and discolorations occasioned by their punctures that the chance of their detection is slight, or, they ascend to the head, where they conceal themselves so effectually among the glumes and sheaths upon which they feed, that one might carefully examine a head and pronounce it free from them, only to find, on shaking it violently, that it contained a whole colony. Here they stay until the head ripens in September, when they descend to feed on the second growth and the surrounding grasses until winter, when they crawl into the thick clump of the *Elymus* and hibernate, appearing again in early May and changing to pupæ. From then on until the middle of the month they feed on any green plant, near enough to be reached, crawling at last to the top of some blade of grass and issuing as adults over ten months from the time of hatching from eggs.

This species in common with the others which occur in long and short winged forms, are usually very thick, where they occur at all; but, the eggs being deposited only upon the *Elymus*, they are limited in their range to a radius of a few feet at most from their host.

They have been observed to feed upon the heads of *E. virginicus* indiscriminately with those of *canadensis* where the two grasses are near together, or near enough for migration, and in the spring, when the larvæ were large and abundant and the grasses small and inconspicuous, they were found upon everything occurring within a reasonable distance of the host.

In view of the fact that wild rye is one of the most deleterious of our grasses, and has been the cause of considerable loss to our stockmen in the past through its propensity to ergotism its eradication from pastures and meadows would of itself be beneficial, and at the same time avoid any possibility of further injury from this species of jassid. Another method which would accomplish both ends sought and still enable us to make use of its valuable food properties would be to closely mow the *Elymus* clumps the latter part of each June. This would cut off the head-forming stems before they had developed ergot, and would destroy the eggs of the shovel-nose, and at the same time leave the grass in good condition for immediate pasture, or, if not pastured, produce a better crop of hay than without the mowing.

THE SPOON-BILL LEAF-HOPPER

HECALUS LINEATUS UHL.

(Pl. xx, Fig. 2.)

Glassocratus lineatus Uhler. Bull. U. S. Geol. and Geog. Surv. III, p. 464, 1877 (♀)
Glassocratus fenestratus Uhler. Bull. U. S. Geol. and Geog. Surv. III, p. 464, 1877. (♂)

This rare species is intermediate in form between the *Dorycephalus* and *Parabolocratus*. The female measures 12 mm. to the tip of the exserted, attenuate ovipositor. The head is 2.50 mm.

long by 2 mm. broad, slightly narrowed in front of the eyes, widening immediately to a spoon-shaped tip, which is thin and slightly reflexed. The body color is bright green with four equidistant parallel lines extending over head, thorax and scutellum; the nerves of the elytra and the ovipositor orange red.

The males are quite different from the females in appearance, and were described by Professor Uhler as *Glossocratus fenestratus*, and have hitherto been regarded as a distinct species. They are much smaller, measuring scarcely 8 mm. to the tip of the style-like pygofers.

The head, thorax and basal part of the elytra are marked like the female, but the ground color approaches orange. The apical half of the elytra and the abdomen are quite different. There is a narrow black band just back of the middle of the elytra and a broader terminal one, between these is a hyaline area with a small curved dark spur extending in on the center of the outer margin. The abdomen is annulated with black, and the terminal segment, valve and attenuate plates black.

The larvæ are narrow, elongate, closely resembling the female in color and in the stripes which extend along the abdomen also.

The species has been reported from Kansas and New Jersey, including only a few specimens in all. There was a specimen in the VanDuzee collection from New York, and one specimen had been taken at Ames and another at Batavia, Iowa.

The larvæ were found on an isolated patch of slough grass (*Spartina cynosuroides*) early in August. They were then nearly full grown.

The adults were taken *in coitu* in the middle of August, and from then on through September were found in some numbers on the limited patch where their food plant occurred.

It is highly probable that the eggs were deposited in the stems of the slough grass before the middle of September, in which case the ordinary time of mowing would be an effectual remedy, and would account for the rarity of the species in cultivated areas, or in sections annually overrun by prairie fires.

PARABOLOCRATUS VIRIDIS UHL.

(Pl. xxi, Fig. 1.)

Glossocratus viridis, Uhler, Bull. U. S. Geol. and Geog. Surv., III, p. 462, 1877.
Parabolocratus viridis, Uhler, Stand. Nat. Hist. II, p. 247, 1884.

Occuring only on the wild oat (*Stipa spartea*) this species furnishes another example of a jassid confined strictly to one species of grass as a host and one to which it is remarkably adapted in coloration and life-history.

The adult female is about 7.50 mm. long by 2 mm. broad, with a parabolically curved, thin edged vertex and a stout abdomen, attenuating posteriorly and extending beyond the rounding elytra. The males are smaller and have the vertex shorter and more obtusely pointed. The abdomen is smaller and does not extend beyond the narrow and nearly parallel margined elytra.

They are both of a uniformly deep green color above, somewhat lighter below, with a narrow band under the sharp vertex, and the eyes dark; the exserted tip of the ovipositor, orange red.

The first brood of the adults appeared the first week in May and remained until the middle of June, disappearing gradually. They feed principally upon the leaves usually about the middle, feeding on either side and either end up, with equal ease.

The eggs are deposited during the last of May and the first week in June. The females usually selecting a position just above the first leaf base and invariably placing themselves head downward, exsert the ovipositor and insert it under the flap of the sheath, gradually working backwards up the stalk for a distance of two inches or more and depositing from seventy to one hundred and twenty eggs within an hour.

The eggs are 1.25 mm. long by .25 mm. broad, cylindrical, of nearly uniform size and obtusely pointed at both ends, arranged in a single series, side by side, curving considerably around the small stem.

The larvæ appeared the last week in June, giving an incubation period of fifteen to twenty days. Upon bursting the egg case the larvæ crawl part way out from under the sheath and remain quiescent in this position for an hour or two when, becoming suddenly active, a flock of very small larvæ may be seen ascending the stalk and distributing themselves upon the leaves, while a row of freshly shed skins with the abdomens still remaining under the sheath, their tips scarcely free from the egg shells, explains the cause of the delay.

When first hatched the larvæ have a characteristic head, depressed, light colored, soon deepening, however, and in some assumes more or less definite stripes of darker which, in the most extreme forms coalesce, and a black specimen is the result. In normally colored specimens there is on either side of a median light line a narrow black stripe originating in a spot on the anterior margin of the vertex, obscured across the disk and becoming marked again upon the posterior margin, enlarged and lobate on the thorax, then narrow with definite parallel margins to the last segment of the abdomen, where they expand and meet at the tip. Besides these there is a broad stripe extending from the inner angle of the eye back across the thorax, where it is margined internally with light to the abdomen, where it margins all but the last segment.

They require about a month to develop, maturing during the latter part of July and the first of August, the adults remaining until the middle of September.

The eggs for the second brood are deposited from the middle to the last of August and the larvæ appear in September, becoming full-grown before winter, when they hibernate, appearing to pupate about the first of May and becoming adults before the middle of this month.

Stipa is another troublesome grass, but too widely and evenly distributed over the prairies to eradicate easily. It may, however, be mowed closely between the 10th and 16th of June to destroy the first brood of eggs and the troublesome barbs of the grass at the same time, leaving an undergrowth of nutritious grass free from jassids. Then, should the adults appear in considerable numbers in August, a second mowing during the latter part would effectually dispose of the second brood of eggs.

Stipa is a very valuable grass to the stockmen of the prairie regions, where blue grass has not been introduced, as it appears two or three weeks earlier than the other wild upland grasses, thus furnishing much earlier grazing than could otherwise be obtained.

PLATYMETOPIUS, BURM.

The American representatives of this genus agree with the European *P. vittatus*, Fab., in form and the generic characters may be stated for our species as follows:

Head distinctly narrower than the pronotum; vertex narrow, produced and very acutely angled, making an acute angle with the face. Face long, narrow, front long, broadest at the ocelli, narrowing above to the tip of the vertex, below to the antennal pit, from them to near its apex nearly parallel margined, narrowing slightly to the clypeus; clypeus strongly constricted before the middle, widening to the broad apex; loræ subovate; pronotum short, strongly produced beneath the eyes, lateral margin long. Elytra with more or less of fine irrorations in the areoles and small hyaline white points near the ends of the cells: two cross nervures and a series of cross veinlets along the hyaline costa always present.

The genitalia seem to be very constant and very similar in the different species and are consequently of little value as specific characters. The last ventral segment in the female is long, obtusely angled or rounding posteriorly. The last segment in the male is angularly excavated; valve large, roundingly pointed. The plates are broad and also convexly pointed, similar in shape to the valve and about twice its length.

The three species occurring at Ames agree in being two-brooded, the broods occurring at about the same time, the adults appearing in June and again in August, remaining less than two months each time. The larvæ, of the three species at least, agree in being broadest at the middle, pointed at both ends, light, with dark margins extending in front of the eyes and meeting under the vertex.

PLATYMETOPIUS ACUTUS SAY.

Jassus acutus, Say, Jour. Acad. Nat. Sci. Phila., VI, p. 306, 1831; Compl. Writings, II, p. 382, 1859.

Platymetopius acutus, Uhler, Bull. U. S. Geol. and Geog. Surv., III, p. 473, 1877.

This widely distributed form may be recognized by its remarkably, acutely, pointed vertex and narrow elongate face, together with a row of black marked cross nervures along the costal border and the finely irrorate elytra. Length, 5 mm.

The larvæ resemble the adults in having the head elongate, narrower than the pronotum. When full-grown they are about four and one-half millimeters long by two millimeters broad in the middle where they are the widest, and from which they gradually and about equally, narrow to an acute point at either end.

Color: There is a broad dorsal light stripe including all the vertex, parallel margined across the thorax where it is slightly wider than between the eyes, constricted on the base of the abdomen and again before the tip expanding on the disk of the abdomen, and again on the extreme tip. This stripe is distinctly red on the center, shading out to creamy white on the margin. The constrictions on the abdomen sometimes completely dividing it into two spots, one on the disk and another on the tip. A marginal black stripe extending the entire length of the body on either side, meeting entirely below the edge of the vertex in front, including numerous fine white maculations. Below, inside the marginal stripe, creamy white.

The larvæ appear the latter part of May, maturing before the end of June, adults appearing before the middle of June and continuing till the middle of July, larvæ again appearing in July, maturing in August, adults from the middle of August on into October. The larvæ were taken in grass lands but were more abundant in shady situations.

PLATYMETOPIUS FRONTALIS VAN D.

Canadian Entomologist, XXII, p. 112, 1890.

This species may be readily recognized by its much darker appearance, being dark brown to black with a broad lemon-yellow face and the small round white spots in the ends of the elytral areoles distinct. It is slightly shorter and stouter than *acutus* and has a shorter vertex.

The larvæ bear a strong superficial resemblance to those of *Deltocephalus inimicus*, but may be readily separated by the presence of the marginal stripe in front of the eyes.

Form and pattern of ornamentation similar to that of *P. acutus* but much shorter and stouter. Vertex very much shorter.

Color: A dorsal light yellow to cream-colored stripe narrowing to a point on the tip of the vertex, broadening with irregular margins on the disk of the abdomen, interrupted before the tip by a narrow black band on base of last segment. Marginal dark stripe extending equally above and below the border of the vertex meeting in a point at the apex, a small lobate expansion of the dorsal stripe midway between edge and tip of vertex just behind the white frontal suture. Below, white, tip of posterior femur and second tarsal joint annulated with black.

Life-history similar to that of *acutus*: larvæ from the last of May nearly through June; adults from the middle of June nearly through July; larvæ from the middle of July nearly through August; adults from the middle of August through September.

Found exclusively in shaded situations; larvæ were swept from undergrowths of grass and weeds.

This species has a quite extended distribution, being credited by VanDuzee to Canada, New York, Illinois, Iowa and Kansas, and as it does not occur in such abundance as some of the other species, and would, therefore, be less likely to appear in collections, it may be assumed to occur throughout the northern United States east of the plains at least.

PLATYMETOPIUS CINEREUS, N. SP.

(Pl. xxvi, Fig. 1.)

Form of *P. acutus* but smaller and lighter colored, equaling *fuscifrons* in size. Length, female nearly 4 mm., male, 3.50 mm.

Female: Vertex nearly twice as long as broad, slightly more than twice as long on the middle as next the eye: light yellowish with fine brownish irrorations; a median light line, broadest on tip fading out on the disk, on either side of this a curved line extending back from the edge on to the disk. Front with the usual dark V under the vertex, remainder of the vertex and the clypeus light lemon-yellow; loræ and genæ slightly, finely maculate with brown: pronotum short, fulvous brownish, lateral margins long, posterior angles obscure, emarginate; between them traces of longitudinal light lines; scutellum large, light yellow, tip darker. Elytra light with fulvous brown irrorations: apical and costal veinlets dark, terminal spots in cells and costal margin whitish-hyaline; tip slightly clouded with dark fuscous.

Male: Smaller and shorter, the vertex is only about one and one-half times as long as broad and the terminal cells are clouded with fuscous

Genitalia: Ultimate segment of the female long, rounding behind narrowly notched in the middle, slightly lobately produced either side of the notch; pygofers light yellow, three times as long as width at base. Male valve large, roundingly pointed, dark at the base; plates roundingly pointed, twice the length of the valve, maculate.

Larvæ: Similar in form to those of *acutus* but smaller; they are about three and one-half millimeters long by one and one-half wide in the middle when full-grown. Widest just before the middle, gradually and regularly narrowing to an acute point at either end There is a broad lemon-yellow dorsal stripe, narrow, wedge-shaped on the vertex with indefinite margin; broad, with definite parallel margins on the thorax, constricted slightly on the base and again before the extremity of the abdomen, bordered on either side by a dark fuscous marginal stripe, irregular in width, narrow before the eyes, meeting under the vertex. Numerous fine white maculations of various sizes dot this stripe.

The larvæ are readily distinguished from those of *acutus* by the absence of red in the dorsal stripe, and from those of *frontalis* by the much more elongate form.

The larvæ were first observed early in June, when they were nearly full grown, and by the third week had disappeared. The adults appeared very thickly by the middle of June and continued in decreasing numbers until after the middle of July. The second brood of larvæ appeared by the last of July and continued in large numbers up to the middle of August. The second brood of adults appeared the second week in August, continuing through September.

This is the smallest known species of the genus, and the most abundant at Ames, occurring everywhere that wild grasses are found. Specimens have also been received from Kansas, Nebraska and Arizona, showing it to have a wide distribution throughout the prairie and plain region at least.

By a process of elimination of grasses not occurring in places where the larvæ were found abundantly its list of host plants may be reduced with a reasonable degree of certainty to three: *A. scoparius*, *B. hirsuta* and *curtipendula*, and from its scarcity in a field of nearly pure *scoparius* its probable host is a *Bouteloa*. This agrees well with its known habitat, which corresponds with that of these grasses.

REVIEW OF THE GENUS DELTOCEPHALUS.

This genus is distinctively a group of grass-feeding species, probably the most important in this relation on account of its wide distribution and large number of species occurring annually in immense numbers.

The genus was originally founded by Burmeister, who characterized it as follows: Vertex acutely triangular, distinctly margined; width between eyes scarcely equaling length; front broad, convex; vertex flat. Fieber in his synopsis of the *Deltocephali* adds the presence of two cross nervures between the forks of the first sector and the second, as a sub-family character. Later writers have omitted the head characters and depended upon the cross nervure alone for group separation. Mr. VanDuzee, to whose careful and accurate work we owe the greater part of our present knowledge of the American Jassidæ, seems to have accepted and used this character against his own better knowledge and judgment, for, in Entomologica Americana (vol. V., p. 93) he says: "This apparently trivial and not infrequently variable character seems almost inadequate for use in separating these two genera, but, correlated as it is with other structural peculiarities, of which it is the most pronounced, it appears to answer well the purpose of its employment, and is much used by Fieber and other European entomologists in synoptical arrangements of the genera." A few years later he described *Athysanus instabilis*, *extrusus* and *sexvittatus*, placing them correctly in that genus despite the fact that most of the types exhibited the two nervures, thus showing that he appreciated the true generic character. The next year, however, he again yielded to the demands of this variable character and redescribed *D. nigrifrons* as *Thamnotettix perpunctata*, although evidently appreciating their specific affinity, as seen by the following extract: "This insect, though quite distinct generically from *D. nigrifrons*, is difficult to distinguish in specific characters; the markings are almost identical, and the form of the facial and genital pieces differ but little." Dr. Melichar, in his recent work on The Homoptera of Middle

Europe, uses this single character in his synoptical arrangements as a primary basis of division for separating groups of genera, but evidently does not accept it in his distribution of species, as he places species that possess the two cross nervures in connection with a similar forking of the first sector to that laid down for the deltocephali in both *Thamnotettix* and *Athysanus:* while on the other hand he includes under *Deltocephalus* species in which the second cross nervure is wanting.

If the only result of these discrepancies was the misplacement of a few species with respect to their apparent natural affinities it would not be worth while, in consideration of the chaotic condition of other jassid genera, to attempt to restrict one genus at the expense of still more overburdening others. But upon an investigation of the actual conditions existing it has been found that species variable in this respect exist in large numbers, and that they have been and are being described over and over again under different appellations, according as their variable venation places them generically, now appearing as a *Thamnotettix*, now as an *Athysanus*, or even as *Eutettix*, and seldom failing to get at least one representative in *Deltocephalus*.

The variable species may be roughly divided into three classes: First, those species which vary between the opposite sides of the same individual, or between two individuals otherwise exactly alike. *Athysanus extrusus* and *servittatus* and *D. concentricus* are good representatives of this class. Second, species which have two distinct forms, both long winged, one form greenish in color and strongly resembling *Thamnotettix*, with only one cross nervure, the other form darker, with subhyaline elytra, possessing two cross nervures, and the other accompanying changes, notably the constriction of the central anteapical cell. *D. nigrifrons*, with its list of synonyms, well illustrates this group. Third, a group in which there are two forms with radically different elytra; one in which the wings are abortive and the elytra only cover the second segment of the abdomen; the venation simple, often rudimentary. In this form the female abdomen is usually very long, ending in an attenuate ovipositor; the male abdomen short, with much enlarged genitalia. The other form, with well developed wings and elytra; the venation variable, but usually strongly Deltocephaloid; both male and female abdomens normal. The forms described as *D. argenteolus* and *minutus*, and as *Athysanus gammaroides* all possess these two forms.

The examination of several hundred examples embracing some twenty species at present referred to five different genera and including all of the above mentioned variations compel the rejection of the cross nervure as an absolute character, or one capable of even specific recognition, except as correlated with other characters, and the re-establishment of the Burmeisteran genus based on head characters. It may be noted, however, that when thus restricted, it contains no species lacking the cross nervure nor any in which it is found to be variable.

The material upon which the revision has been based, and which has been accumulating during a number of years past, consists mainly of the following: Types of the ten VanDuzee species; types or typical specimens of all but two of the Gillette and Baker species, together with a series of several hundred Colorado specimens, received through the kindness of Professor Gillette. Twenty European species of the genus as defined by Melichar, more than half of them direct from him, which, in connection with his recent synopsis, furnish a good basis for comparison of the American and European faunæ. The Van Duzee material in the genus outside of the types, which, together with them, includes all but one of the eighteen described species which he listed in his catalogue. And, lastly, the college collections of thousands of specimens of adults and larvæ, together with a large series of balsam mounts of larvæ, elytra and wings, structural details and dissected genitalia for microscopic examination. These, embracing twenty-five species, among them the one lacking from the VanDuzee material, and thus complete the series of described American species.

After restricting the genus it was found that it could be separated into three well defined groups, each of which has its parallel in the European fauna. In fact, two out of the three groups possess species common to both continents. The first, or reflexed veined group includes species with short pronotum and sharp margined head; the elytra have little or no appendix and the costal veinlets are white-marked, strongly reflexed in one series and nearly right-angled in another. Of this group *bilineatus* represents one extreme and is closely related to the European *formosus*, while *ocellaris* common to both continents, and *sayi* closely related to the European *flori* and *socialis*, represents the other. They agree in being of a general light brown color with definite markings, and are two-brooded as far as known. The larvæ are light, with four brown stripes. The species of the second group have longer pronotum, longer, narrower elytra, with an appendix, never possessing reflexed veins. Here is placed *debilis*, which is closely related to the European *abdominalis* and *melscheimeri*, which is intermediate between the European *notatus* and *striatus*. The group is nearly unicolorous, without distinct markings; the larvæ are unicolorous, usually yellowish in color. The third group, of which *inimicus* is the best known, have shorter, rounding, more centrally produced heads, with a row of points on the anterior margin of the vertex, extending down to the antennæ on either side. The central ante apical cell is constricted in the middle and divided by a short nervure. They are closely related to the European *pulicarius*, and, like that species, not typical Deltocephalids. They are of a general dark color, more or less maculate. The known larvæ are dark margined or banded.

It has been thought best to place this group here for the present, though in a revision of the family it may prove necessary to establish another genus which shall include also such forms as *nigrifrons*.

SYNOPSIS OF AMERICAN SPECIES.

A. Vertex strong, disk flat or concave, margin in front of eyes straight. Ocelli on a level with the disk of vertex before the upper margin of eye.

B. Pronotum short, more than twice broader than long, nearly truncate behind, posterior angles obtusely rounding, side margins long, elytra without a distinct appendix—light colored species with brown markings, larvæ light, with four brown stripes.

c. Elytra moderately long, with two outer apical veinlets strongly reflexed to the costa, the next one meeting the costa at nearly right angles, all three white, dark margined.

d. Pronotum four-lined, lines sometimes coalescing, black.

e. Vertex longitudinally lined or else spotted, ground color, yellow; front, narrow..............*bilineatus*.

ee. Vertex transversely lined before the eyes, general color white, front broad, inflated.......*albidus*.

dd. Pronotum cinereus, never distinctly dark-lined.

e. Third apical cell larger than anal one, face dark above, light below; species four mm. or more long.

f. Face light or fuscous above, shading out below, no sharp line of demarkation, claval veins not uniting, vertex short, nearly right angled, male genitalia inflated, plates roundingly pointed; species nearly unicolorous above, except a broad spot in third apical cell..............................*inflatus*.

ff. Face black above, white below, line of demarkation sharp, vertex, long, acutely pointed, dark markings above, sharp, veins on clavus coalescing through the middle third, male plates long, acutely, slightly concavely pointed ....*reflexus*.

ee. Third apical cell smaller, or only equaling anal one, face usually entirely dark; species less than four mm. long.

f. Length three and one-half mm. or over, ventral segment of female, with four black, comb-like teeth, male plates broad, almost truncate; species brownish fuscous above.. .... *pectinatus*.

ff. Length, three mm. or less, ventral segment of female with a broad median projection slightly notched in the middle, arcuated either side, male plates roundingly pointed; species light cinereus above.... *abbreviatus*.

cc. Elytra shorter, broadly obtusely rounded, with the two outer apical veinlets short, at nearly right angles to the costa, third veinlet running distinctly to the posterior margin; species stout bodied, with chocolate brown markings.

d. Vertex slightly longer than broad; species not over three and one-half mm. in length, short and stout, with a distinct marking.

e. Dark chocolate brown above, nearly black below, a distinct inverted T on apex of front, claval sutures reticulate, central anteapical, cell divided; male valve large, inflated ....*ocellaris*.

ee. Light brown above and below, no reticulations on clavus, central anteapical cell entire, male valve normal, not larger than ultimate segment .... *sayi*.

dd. Vertex very broad, breadth and length about equal; species over four and one-half mm. long, markings brownish fuscous or wanting, male plates broad, short, obliquely truncate ....*configuratus*.

BB. Pronotum longer, hardly twice broader than long, posterior angles strong, sides short, postero-lateral margin nearly parallel with scutellar margin of elytra, elytra long with appendix, costal veinlets never reflexed, only the first one, ever even right angled; species unicolorous, yellows or fuscous, larvæ unicolorous.

c. Elytra only slightly overlapping at tip. Central ateapical cell neither markedly constricted nor extending posteriorly much beyond the adjacent cells, equaling or shorter than outer discoid cell.

d. Elytra distinctly green. Vertex lighter, not distinctly lined, tergum and venter and sometimes all of lower side of face varying to black.

e. Form stout; length four mm. or over........*debilis*.

ee. Form more slender; species three mm. or less in length......................................*minimus*.

dd. Elytra not distinctly green, hyaline yellowish, or with the nervures fuscous margined; vertex unicolorous or lined, not spotted.

e. Male valve enlarged, inflated, rounding posteriorly concealing all but the tips of the small plates; female segment slightly angularly excavated...... ....*melsheimeri*.

ee. Male valve normal, less than half the length of the plates, last segment in female produced more or less notched.

f. Species distinctly yellow, male plates not longer than broad...................*oculatus*.

ff. Species fuscous or greenish, with fuscuous markings, male plates distinctly longer than broad.

g. Vertex acutely angled; species green, with slight fuscous markings; male valve pointed, female segment with truncate process............*sylvestris*.

gg. Vertex little more than right angled; species, brownish fuscous, with light nervures, male valve large, obtusely rounding, female segment deeply notched .... *cinereus*.

cc. Elytra broadly overlapping at the tip, central anteapical cell elongate, constricted, distinctly longer posteriorly than the cells on either side, longer than the other discoid cell.

d. Vertex orange yellow, general color yellowish, styles distinctly exceeding the long plates... .... *auratus*.

dd. Vertex light fuscous with brownish maculations general color fuscous, styles not visible beyond the short, broadly truncate plates ....*signatifrons*.

AA. Vertex short, disk convex, margin in front of the eyes arcuated, tip bluntly produced; ocelli below the disk of the vertex in front of the middle of the eye.

BBB. Pronotum long, distinctly angled behind, side margins long; species dark maculate or black; a series of small points on the anterior margin of the vertex, between the ocelli. Known larvæ margined or banded.

c. Clavus with a series of reticulations between the outer nerve and the suture; species fuscous, with black points on the vertex, elytral nervures light.

d. A pair of large, round, black points on anterior margin of each, vertex, pronotum and scutellum; length four mm... *inimicus*.

dd. Points small, usually confined to the vertex, species shorter, length three mm.

e. Elytra distinctly longer than abdomen, vertex acutely produced in the middle; male plates convexly pointed, width at middle two-thirds their length. ... .*weedi*.

ee. Elytra about equaling abdomen, vertex more obtusely rounding, male plates concavely attenuate, four times as long as width in the middle.. .... *compactus*.

cc. Clavus without reticulations along suture; species black, with white points on vertex, outer two apical veinlets white, costa yellow..*flavocostatus*

DELTOCEPHALUS BILINEATUS G. & B.

Hemiptera of Colorado, p. 85.

This species is very closely related to the *European D. formosus*, and like it, is very variable in color, ranging from almost black through distinctly black-striped forms to red-striped forms with black spots, and even on to those in which the black is almost wanting. It may be readily distinguished, whatever its color, by the reflexed white veinlets and its narrow elongate front. The dorsal stripes are always indicated, though variously colored and spotted. The general ground color beneath is some shade of yellow and the long plates of the male are broadly black tipped. This species was described from Colorado and has been collected at Ames, also in New Hampshire by Professor Weed. The Iowa specimens were taken in July from the undergrowth in a woody pasture where *Scaphoideus jucundus* occurred, which species it sometimes closely mimics.

DELTOCEPHALUS ALBIDUS N. SP.

(Pl. xxiii, Fig. 1.)

Clear milky white; a transverse line on the middle of the vertex, a circle around the tip and four stripes on the pronotum, black. Elytra flaring with reflex, dark margined costal veinlets. Length, 4.25 mm. Width of elytra on center of costa, 1.75 mm.

Vertex rather more than twice longer on middle than at eye, longer than width between the eyes, anterior angle slightly acute. Front broad, strong, twice wider on ocelli than at clypeus, sides straight, angle of the vertex less than forty-five degrees; genæ short, rounding, outer angle obscure; pronotum two and one-fourth times wider than long, feebly emarginate posteriorly; posterior angle indefinite. Elytra flaring, without an appendix, obtusely rounding posteriorly; venation distinct, the two outer apical veinlets strongly reflexed to the costa, the third one at nearly right angles to the costa and with the apices of the second and third anteapical cells forming nearly a straight line to the tip of the clavus, thus leaving two costal cells and three terminal cells, of which the outer one is the largest.

Color: Pearly white; above, tip of vertex triangularly margined with dark; a transverse slightly curved line on vertex, four longitudinal stripes on pronotum, the inner pair continuing across the scutellum and extending forward on to the base of the vertex, where they diverge, dark brown or blackish. Sutural and apical margins of elytra and anterior margin of the three outer veinlets lined with black. An oblique interrupted band from the tip of the scutellum to the center of the elytra, deep black. Tergum lined as in larvæ, the outer pair of stripes meeting above on the pygofers, forming a black V. Abdominal pleurites with a black margin and central dot.

Genitalia: Male valve large, acutely angled; plates twice the length of valve, narrowly, slightly concavely, pointed. Ultimate ventral segment of female twice the width of the penultimate; posterior margin divided into three broad lobes, central lobe notched one-half its depth. Described from numerous specimens.

Larvæ: Pearly white with four narrow brown stripes. Vertex acutely angled, three times as long on the middle as next the eye; body narrow; abdomen long, gradually tapering, acutely pointed. Color, pearly white above with two brown stripes arising just under the tip of the vertex passing up either side on to the disk, where they broaden, narrowing again toward the base, extending as narrow parallel lines ending abruptly on the posterior margin of the ultimate segment; a broad stripe on either side, arising behind the eye and extending back along the dorsum just inside of the white margin, meeting at the tip of the abdomen. A white spot on each abdominal segment within this stripe: a narrow white lined triangle on anterior third of vertex enclosing the point. Below, two stripes arising within the first pair just under the vertex, running broadly and obliquely across the face just under the eye, obscure or wanting on the thorax, margining the connexivum and meeting on the genitalia. Legs with small round spots: posterior femora with a long dark line; middle femora with a transverse band below. These at rest complete the ventral stripe across the thorax

This exceptionally well marked form may be easily recognized by its clear white ground color. It has been collected at Ames for several years but has not been received from any other locality.

The larvæ were first taken May 26th. They were then nearly full-grown and remained abundant for two weeks, disappearing by the middle of June. The adults were taken the 3d of June, and by the middle were exceedingly abundant, continuing in decreasing numbers up to the middle of July. The only appearance of a second brood was the capture of an adult male August 18th.

The field where this species occurred had been closely mowed June 25th, and the inference is that eggs had all been deposited in the grass stems above the point of cutting and must have been almost totally destroyed by the mowing. From these facts and through comparison with the life-history of other species their life-history may be, with reasonable certainty, completed as follows: Second brood of larvæ from the second week in July on to the middle of August; adults through August and September.

No definite food habit can be assigned, as there was a rich variety of native grasses where it occurred so abundantly. It was not, however, found on a field of *Andropogon scoparius* nor where the *Bouteloas* predominated. Insectary tests to ascertain its food plant failed because of its great susceptibility to *Sporotrichum* in confinement.

DELTOCEPHALUS INFLATUS N. SP.

(Pl. xxii, Fig. 2.)

Form intermediate between that of *albidus* and *configuratus*. Color very similar to *configuratus* usually a dark blotch in the third apical cell. Length, 4.25 to 4.75 mm. Width across center of costæ, 1.75 mm.

Vertex scarcely twice as long on middle as next the eyes, one and one-fourth times as long as broad. Front more than twice as wide at ocelli as at clypeus; facial angle acute, as in *albidus;* front less inflated. Pronotum short, weakly angled; elytra flaring, variable in length, usually exceeding the abdomen, venation similar to *albidus*, costal veinlets not as strongly reflexed, shorter.

Color, dirty yellowish-white to light fuscous with faint markings, tip of vertex ivory white, narrowly, interruptedly margined with dark, a line just inside the margin before the ocelli, an obscure rectangular mark just on either side the center and an oblique spot near the base, brown. Pronotum and scutellum faintly lined. Elytra sub-hyaline, nervures light, sometimes faintly margined; oblique band reduced to two spots: usually a dark blotch in the third apical cell and reflexed nerves lightly margined. Below, dirty white; upper half of the face usually dark with white arcs. Tergum with four black stripes, outer pair widest at base.

Genitalia: Ultimate ventral segment of female very long, central fourth slightly produced, notched in the center, arcuated and dark colored each side of the notch. Male genitalia much enlarged; pygofers enlarged, inflated, spoon-shaped, their tips compressed; last tergite much enlarged, inflated, compressed laterally and terminally against the pygofers. Valve large, acutely angled, plates small, about twice the length of the valve, roundingly pointed, distended, and sometimes notched at tip by the sharp edge of the pygofers. Described from eighteen specimens.

The enlargement of the male genitalia, though not peculiar to this species alone, is rendered all the more striking from the fact that it is ordinarily met with only in the males of short-winged forms usually placed in the genus *Athysanus*, while long winged forms of the same species in that genus have genitalia of normal size. The males of this species, however, are all long-winged and have constantly deltocephaloid venation and enlarged genitalia.

This species very much resembles *reflexus*, but has a broader head, stouter vertex and longer elytra, giving it a linear rather than a wedge shape. Specimens have been collected at Ames for a number of years and two examples were received from Colorado through Professor Gillette.

Adults have been taken rather sparingly through the last half of June, rather commonly through the first week in July, and one battered specimen the first of August. No larvæ have been taken or food plant determined.

DELTOCEPHALUS REFLEXUS N. SP.

(Pl. xxii, Fig. 1.)

Form very similar to that of *albidus*, but the vertex is longer, narrower and more acutely angled and the elytra more rounding. Light cinereus above, the upper half of the face sharply black, lower half white. Length, 4 to 4.50 mm. Width, 1.75 mm.

Vertex: Length on middle nearly three times that at eye, nearly twice longer than wide, anterior angle acute, tip blunt. Front narrower above than in *inflatus*, facial angle slightly more acute; genæ moderately full, outer angle distinct; loræ only meeting the extreme tip of front, enclosing the clypeus. Pronotum short, truncate behind, posterior angles indefinite; elytra flaring, without an appendix; costal veinlets reflexed, even more strongly than in *albidus*; third apical cell wedge-shaped, twice larger than anal, veins on clavus coalescent through the median third of their length.

Color: Soiled white to light fuscous above; tip of vertex ivory white; triangle with a black margin, line near the margin before the ocelli; rectangular spot on disk, an oblique spot at base of vertex, as in *D. inflatus* well marked, brown. Pronotum soiled white with faint indications of stripes; elytra sub-hyaline, soiled yellowish-white, oblique band reduced to two spots, one on the clavus near the pronotum, the other between the first and second sectors unequally divided by the white cross nervure; apical and reflexed veinlets broadly white, darkly lined before as is also the outer apical margin; tergum broadly black at base, lined near tip; outer pair of lines approximate behind. Below upper half of face sharply black, light arcs more or less distinct; lower half sharply white; venter fuscous.

Genitalia: Ultimate ventral segment of female about half as long as broad, margin roundingly produced in the center, notched. Disk light, produced part black, pygofers broad, short, brown, maculate with white. Male valve broad, obtusely pointed: plates broad at base, concavely, attenuately pointed, three times the length of the valve, equaling pygofers. Described from numerous specimens.

Larvæ resembling those of *albidus* in form and *sayi* in color, but with more definite stripes. Upper half of the face black.

Vertex: Sides acutely angled, point obtusely rounded; body slender, tapering, last abdominal segment, long, narrow. Color above, striped with olive and white, a narrow median white line from tip of vertex to the tip of abdomen slightly expanded on the last segment, a slightly wider light line margining the vertex next the eye on either side and running to the posterior margin of the penultimate segment of the abdomen; a narrow white margin on either side from behind the eyes to the last abdominal segment

The pupæ have a small round spot in the outer light line near the anterior margin of the thorax and a larger oblique mark near the posterior margin of the wing-pads; base of both rows of hairs on the abdomen with small round white spots. Below: Face, upper half black, lower half sharply white, as in adult, the dark line continuing along the fermora and connecting with them as in *abidus* larvæ.

This species and the three following strongly resemble each other. They are most accurately separated by the structure of the genitalia, which have proved to be very constant in the hundreds of specimens studied, as in fact they have for the whole genus, though tested by the study of nearly 5,000 specimens. It has been collected in abundance at Ames this season, and one Colorado example received from Professor Gillette.

It was taken for the first time, June 3rd, when it occurred as full-grown larvæ and adult males. By the middle of June the larvæ had disappeared and the adults were numerous, continuing so well into July. Small larvæ were found the third week in July, and from then on they were numerous until the second week in August, when they had become full-grown and begun to disappear. The adults appeared by the end of the first week in August, becoming abundant by the middle and continuing to be found throughout the fall. One female, dissected October 26th, showed three fully developed eggs and no smaller ones, probably indicating that the rest had been deposited before then. This species occurs well distributed over the prairies, but has not been found on the field of *Andropogon scoparius*.

DELTOCEPHALUS PECTINATUS N. SP.

(Pl. xxii, Fig. 3)

Form and color nearly of *reflexus*, slightly smaller; vertex distinctly shorter; face all dark. Distinctly separated by the venation and genitalia. Length, 3.50 to 4 mm.

Vertex two and one-fourth times as long as next eye, one-half longer than wide, sides slightly acute, tip nearly pointed; front short, more inflated than in *reflexus*, similar to *albidus;* clypeus short, narrowed at apex, width at base equaling length: loræ broad, sutures strong: pronotum two and one-fourth times wider than long, truncate behind. Elytra less flaring, slightly shorter than in *reflexus;* venation on corium similar: third apical cell smaller or only equaling the anal; veins on clavus not coalescent; abdomen very broad, depressed.

Color: Sordid yellowish-white above, markings as in *reflexus;* the oblique line on anterior margin of vertex nearer edge, less distinct; elytral veinlets not as strongly margined. Below: Face usually all dark, at least no distinct line of separation of color when lighter below; front always dark or fuscous to the base; tergum as in *reflexus;* venter usually darker.

Genitalia; Last ventral segment of the female less than half as long as broad, nearly truncate behind, with four narrow black comb-like teeth; pygofers more than twice as long as breadth at base, maculate; male valve equilaterally triangular, one and one-half times as long as their combined breadth at base, very slightly narrowing, obtusely rounding to truncate behind; shorter than the pygofers. Described from numerous examples.

Larvæ very similar in form and ornamentation to *reflexus;* color, olive green to fuscous, longitudinal stripes less distinctly marked; a white median stripe extending from vertex to tip of abdomen, widening on terminal segment, lateral stripes very obscure, often appearing as dots on the abdomen; body shorter and stouter, vertex shorter and broader, the oblique markings in the pupæ indistinct.

This is a slightly smaller and darker species than *reflexus*, the vertex is less pointed and the elytra inclined to be less flaring, giving it a more compact appearance.

The first adults were taken May 26th, becoming more numerous up to the middle of June, then decreasing in numbers into July. This species had not been recognized as distinct from the preceding until after the time for the first brood of larvæ, so no observations were made upon them. The first larvae recognized as belonging to this species were taken August 4th in a different locality from the preceding, and where *reflexus* did not occur. They were then nearly grown, and the adults were beginning to appear. Two weeks later the adults were abundant and the larvæ gone. The adults continued abundant until into September, and could be found to the end of the season.

This species was taken wherever *B. hirsuta* was found, and never anywhere else during the season. *B. curtipendula* however usually occurs with *hirsuta* so that it could not be excluded on that ground, but the latter also occurs where *hirsuta* does not, and in no such locations has this species been taken as yet. Within the limits of the area it appears to feed indifferently on either plant, so that if restricted to the one it is probably a restriction of egg deposition.

DELTOCEPHALUS ABBREVIATUS N. SP.

(Plate xxii, Fig. 4.)

Form of *pectinatus* but much smaller. Smaller than *melsheimeri.* Light cinereus in color; length, 3 to 3.25 mm.; width, on center of costa, 1.25 mm.

Vertex shorter than in *reflexus;* slightly, roundingly pointed, twice as long on the middle as next eye, about half longer than breadth between the eyes; front slightly proportionately longer than in *reflexus*, side straight; clypeus longer than broad at base; pronotum very short, truncate behind; elytra variable in length, without an appendix; veins on clavus not united; outer apical cell smaller than anal.

Color, light cinereus, above; markings as in *reflexus* strong; triangle around the white tip complete, broad; oblique line on margin usually reduced to a dot midway between the ocelli and tip; transverse band nearly complete; slightly crescentiform; oblique spots at base of vertex usually strong, sometimes a row of spots near the front margin of the pronotum. Elytra light cinereus, nearly all the nervures fuscous margined; apical cells and anterior margin of reflexed veinlet broadly black margined; tergum dark at base, two apical segments creamy white, with a V-shaped black margin in the female. Below, front fuscous; clypeus, loræ and genæ usually light with fuscous sutures; venter fuscous.

Genitalia: Ultimate ventral segment of the female twice wider than long, slightly emarginate posteriorly; middle fourth produced half its width, truncate, notched; arcuated and dark colored each side of the notch. Male, last ventral segment very short; valve large, acutely angled, much longer than the segment; plates broad, convexly pointed; about twice the length of the valve; pygofers elongate, narrow, much exceeding the plate. Described from numerous examples.

Larvæ: Resembling those of *reflexus* but much smaller in size. Color, olive green to fuscous; dark markings broken up into quadrate areas with fuscous margins. Vertex acutely pointed; body short, broad, abruptly terminated; median line narrow, broadening on the abdomen, where it is obscure; lateral lines usually complete; a transverse line on the vertex, one-third the way back from the point, white; vertex light margined, except posteriorly.

Pupæ with oblique mark and spot in lateral white line present but obscure. Below, as in *reflexus*, dark marks nearly black.

This is the smallest species of the *reflexus* group; this and its cinereus color will enable one to separate it from *pectinatus* to which its dark face allies it, and which separates it from *reflexus*, or it may be readily separated from either by its genitalia. It has been collected abundantly at Ames, but it is not known from any other locality, although doubtless it will be found to occur with the other members of the *reflexus* group throughout the range of the *Bouteloas*.

Adults and full grown larvæ were first taken in company with the preceding species from *Bouteloa hirsuta* August 4th and 8th, 1896. By the middle of the month larvæ had disappeared, adults continuing numerous throughout the month and on until the middle of September. The spot where this species was found was a high gravelly pasture, the tops and sides of the knolls being covered with this grass, to which it seemed strictly confined.

DELTOCEPHALUS OCELLARIS FALL.

Cicada ocellaris, Fall. Hem. Suec., II, p. 20, 13 (Vide Melichar).

This is a much stouter and darker species than *sayi*, occurring commonly throughout central Europe, and has been received from Colorado. The vertex is much broader than in *sayi;* width between eyes nearly equaling length; pronotum very short; elytra very broad; nervures strong; clavus reticulated, central anteapical usually unequally divided. Color much darker than in *sayi;* light markings on vertex variable, not concentric; face dark, an inverted white T on apex of front; venter and genitalia shining black. Readily separated by the immense, convexly inflated shining black valve and the large, convexly margined plates of the male. Length, 3.50 mm. Width, 1.50 mm. The Colorado specimens were taken by Professor Gillette in Laramie county, July 5th.

DELTOCEPHALUS SAYI FITCH.

(Pl. xxiii, Fig. 2.)

Amblycephalus sayi Fitch. Homop. N. Y. State Cab., p. 61.
Jassus sayi Walk. Homop. IV, p. 1158, 1852.
Deltocephalus sayi Uhler. Bull. U. S. Geol. and Geog. Surv., IV, p. 511, 1878.

This species may be swept sparingly almost everywhere, but occurs throughout the summer in immense numbers on blue grass in woody pastures, either high or low.

The adults are short and compact, with a rounding pointed vertex and broad, almost truncate elytra. In color they are rich brown with the tip and two concentric bands on the vertex lighter, and two bands of lighter on the elytra, one at the base and a broader one back of the middle. On these bands the nervures are distinctly white. In form and ornamentation closely resembling *D. flori* Fitch, but readily separated by the genitalia. Length, 3.5 mm.

The larvæ are more elongated than those of *inimicus* and have a narrower and more definitely angled vertex. They are colored very much as in the adult, but the markings are different. There is a narrow median line of white extending from the tip of the vertex to the last abdominal segment, where it broadens and nearly covers the tip; the inner margin of the eyes, a concentric band near the point of the vertex, and two spots just back of the center on either side are lighter. A broad marginal stripe from the eye back, an indistinct, narrow one from the inner margin of the eye, which may break up into white spots, one on the posterior margin of each abdominal segment, and a second row of dots midway between the first and the marginal stripe on either side, complete the white markings of the body. The face is light with fuscous striations.

The larvæ were first taken sparingly from upland prairie the second week in June. They were full-grown and were probably belated ones, as the adults had been taken during the first week. On June 16th the first observation on wooded pastures was made and the adults were swept in immense numbers from rank blue grass. They continued to be found in great numbers whenever observed throughout the remainder of the season. The larvæ were next observed July 11th, when they were somewhat over half-grown, and by the last week in July they were full-grown; abundant, and fresh looking adults were also numerous. Again on the 5th of September nearly full-grown larvæ were observed to be numerous, as also were the adults. Later in the month the larvæ were becoming rare and the adults still very plenty, as they continued to be throughout October. Six females dissected on the 27th of October showed no signs of eggs, from which it might be inferred that they had been deposited. On this assumption, which coincides well with the early appearance of the spring brood of larvæ, the following arrangement of broods would seem very probable and harmonize well with the dates given above.

First brood of larvæ through May and the first week in June, adults from the last week in May until the middle of July; second brood of larvæ, last week in June until the first week in August; second brood of adults from middle of July through

August; third brood of larvæ from middle of August until the last week in September; third brood of adults from the first week in September through October.

DELTOCEPHALUS CONFIGURATUS UHL.

(Pl. xxiii, Fig. 3.)

Bull. U. S. Geol. and Geog. Surv., IV, p. 511, 1878.

This widely distributed species is the largest of the genus in America, and though the coloration is often so faint as to leave it almost unicolorous above, it may be easily recognized by its broad, blunt head as well as by its peculiar genital structure. The last ventral segment of the female terminates in an attenuate bifid black process, and the male plates are strong, broad and obliquely truncate.

In the definitely colored individuals there is a white cross on a white margined vertex of fuscous and alternating light and fuscous stripes on the pronotum. The nervures of the elytra are white, margined more or less strongly with fuscous. The elytra vary in length, usually longer than abdomen. A median impressed black line on the vertex is never entirely wanting. Length, 4.50 to 5 mm. Closely related to *D. bohemani* Zett, but with male plates distinctly shorter, and not laterally excavated.

The larvæ may be separated from *sayi* by the broader head, rounder vertex and stouter form and from any other of the striped larvæ by the fuscous striated front. It is of a pale brown above, with three indistinct stripes and a row of dots just inside the narrow light margin on either side of the abdomen. Front light, with indistinct fuscous striations.

This species was first taken in great abundance as full-grown larvæ and freshly issued adults on May 2nd and 12th. Within two weeks the larvæ had all disappeared, while the adults were very numerous throughout June, and a few were found in July.

This species occurred with *albidus* on the field that was mowed June 25th, and as recorded for that species, was practically exterminated by the process. Though the field was under continual observation throughout the remainder of the season the only indication of a second brood was the sweeping of a half grown larva July 16th. These facts indicate that it has a very similar life-history to *albidus*, the broods however occurring from one to two weeks earlier, the second brood of larvæ probably appearing the last week in June and continuing through July; the second brood of adults from the last week in July through August, larvæ again appearing sometime in September, going through the winter to appear again as adults in May.

Facts which materially strengthen these conclusions are that while in these two species exterminated, known facts in their life-history indicate that the eggs would have been deposited before this time, and would thus be subject to destruction, while other species occurring on the same area, whose eggs are known to be deposited at other periods, remained abundant throughout the season. That close mowing at the proper time was an effectual check seemed to be thoroughly demonstrated for these two species. There would be a second period, when the eggs of the second brood might be destroyed, occurring, according to the above determinations, toward the last of August.

DELTOCEPHALUS DEBILIS UHL.

(Plate xxiii, Fig. 2.)

Deltocephalus debilis Uhler. Bull., U. S. Geol. and Geog. Surv., II, p. 360, 1876.
Deltocephalus minki Fall. Provancher. Pet. Faun., III, p. 279, 1889.

Although this is a very variable species in color, size and genital characters, and approaches in its different variations three recognized European species, *abdominalis*, Fab., *falleni* Fab., *minki* Fieb., the intergradation of these varieties prevents their separation, for this country at least. An examination of the European material at hand indicates a similar variation in their fauna.

This species may be briefly characterized as follows:

Color, usually deep green, more or less marked with black below, sometimes even appearing on the elytra. Vertex variable, more or less distinctly, acutely angled; length usually slightly greater than width; front strong, broad above; sides straight; loræ long; genæ with the lateral margins excavated below the eyes; outer angle very distinct, scarcely rounding below the clypeus; elytra, length variable, usually exceeding abdomen; venation distinct, central anteapical cell large, first anteapical narrow, elongate, nearly parallel margined.

Genitalia: Ultimate ventral segment of female varying from rounding behind with a deep notch to nearly truncate, slightly lobed each side of a shallow notch. Male valve obtuse, variably exposed; plates very broad at base, slightly longer than wide, bluntly, obtusely pointed, lined or spotted with black; length, 4 mm.

This well known species is comparatively rare at Ames, a few specimens being taken each year. During this season adults were taken from the first week in June until the first week in July, usually found in wooded regions.

DELTOCEPHALUS MINIMUS N. SP.

(Plate xxiv, Fig. 4.)

Form and color of *debilis*, but less than half the size; length of vertex more variable even than in that species; the smallest species in the genus; length, female, 2.75 to 3 mm.; male, 2.25 to 2.50 mm.

Vertex very variable in length, usually convexly and acutely pointed in the female, longer than the pronotum; roundingly rectangular in the male, about equaling the pronotum; front strong; similar to *debilis* broader on the clypeus; clypeus broad, one-half longer than wide; loræ broad, nearly semi-circular; genæ much narrower than the eyes, lateral margin short and straight.

General color like that of *debilis;* vertex, margins of the pronotum and scutellum yellowish-green; disk of the pronotum and basal part of the elytra dark green; apical portion of the elytra lighter. Below, front fuscous with lighter arcs, rest of face greenish; tergum and venter greenish or fuscous, varying to black; legs usually distinctly black below.

Genitalia: Ultimate ventral segment of female broad; posterior margin roundingly produced from the lateral angles, narrowly arcuated and notched medially, black tipped; pygofers nearly twice as long as width at base, equaling the black ovipositor; male valve large, triangular; plates broad, convexly pointed, three times the length of the valve, usually a dark spot beyond the middle of each. Described from numerous examples.

Larvæ: Small dark green forms with acutely pointed vertices and black faces and eyes; vertex convexly, acutely pointed; body long, tapering from eye back to tip of abdomen; hairs on abdomen distinct; green above, vertex lighter, ocelli black. Below, all dark fuscous to black in the later moults, especially noticeable on legs.

This very small and distinct species occurred abundantly on a patch of raw prairie adjoining the *Adropogon* field, where the *oculatus* occurred so thickly, and was found at the same time and in the same stages as that species throughout the season, but did not occur on the isolated *Andropogon*. *Sporobolus heterolepis* and the *Stipa* were very plentiful, where they were most abundant, either one of which would harmonize well with its green color.

DELTOCEPHALUS MELSCHEIMERI FITCH.

(Plate xxiv, Fig. 1.)

Amblycephalus melscheimeri Fitch. Homop. N. Y. State Cab., p. 61.
Deltocephalus debilis Osborn. Bull, Iowa Exp. Sta. No. 13, p. 100; No. 20, p. 714.
Deltocephalus affinis Gillette and Baker. Hemiptera of Colorado, p. 84.
Deltocephalus auratus Gillette and Baker. Hemiptera of Colorado, p. 85 (Female).

This is a slightly smaller species than *debilis* and with more general fuscous markings.

Vertex one-half longer on middle than at eye, width between eyes greater than length; obtusely, slightly roundingly angled. Front narrower below than in *minimus;* genæ long, not distinctly angled outwardly. Elytra narrower than in *debilis*, venation similar, outer anteapical cell short, rounding; ultimate ventral segment of female short, truncate behind, usually medially depressed, giving it a strongly, angularly excavated appearance: male valve large, inflated, rounding posteriorly, concealing all but the tip of the short plates. Color varying from pallid, with subhyaline elytra to fuscous, with heavily fuscous margined elytral nervures; tergum venter and male genitalia black; length 3.75 mm.

Larvæ, form of those of *inimicus*, nearly; vertex longer than broad, definitely angled; body stout; abdomen short; color light yellow, much lighter than the dorsal color in *inimicus*, without markings of any kind.

This is a widely distributed and well known species, occurring in immense numbers on blue grass in lawns and open pastures, and frequently met with in various other open situations, never occurring, however, very far within the margin of shaded areas, where it gives place to *sayi* and *Athysanus curtisii.*

Work was not commenced early enough to determine fully the life-history, but broods the past season were recognized on blue grass as follows: Adults from the middle of May until the last of June; larvæ from the first week in June till the middle of July; adults from the first week in July through August; larvæ through August until the middle of September; adults from the middle of September through the season.

It is the only American representative of a series of species with enlarged male valve and concealed plates, and is thus rendered very distinct in our fauna. The closest allied form seems to be the European *D. striatus* L , with similar recorded habits.

DELTOCEPHALUS OCULATUS N. SP.

(Pl. xxiii, Fig. 4.)

Form and size very close to that of *melscheimeri*, slightly smaller, resembling the European *D. metrius* Flor in size and color, but with a sharper vertex. Length, 3.50 mm. Width, .99 mm.

Vertex variable, at least one-third longer than broad, one and one-half times length next eye, convexly pointed: front broad, straight margined; genæ arising from the outer corner of the eye, moderately curved below; elytra long and narrow, similar in form and venation to those of *melscheimeri*, but with nervures less distinct.

General color of the female light yellow; eyes and tip of last segment purplish black: male slightly greenish-yellow; tergum and venter darker front with fuscous arc and in fall broods the vertex is marked with brown.

Genitalia: Ultimate ventral segment of the female short, lateral angles slightly acute, central half of posterior margin narrowly produced: length of produced part equal to its width at apex; apex with three lobes indicated, produced part dark colored; male valve triangular, shorter than broad, plates broad at base, rapidly, roundingly narrowing to the narrowly produced, black-tipped points. Described from numerous specimens.

Larvæ: Tawny yellow, sometimes with light fuscous marking; a bright purple spot on either eye in life or in freshly mounted specimens; vertex narrow and longer, more acutely pointed than in *melscheimeri;* body narrower, more gradually tapering. In general color is more intense than in *melscheimeri*, and approaches *inimicus;* late or exposed forms sometimes distinctly fuscous marked. Living specimens are readily separated by the distinct purple spot on the eye.

This species has been received from Colorado, and has been collected at Ames prior to this season. It was first taken this year as adults the last week in May, and from then on through July. Larvæ were taken abundantly during the second and third weeks in July, disappearing by the end; adults were again found from the middle of July through August; larvæ again appearing in August, maturing through September; adults from the first of September on through the season.

It has been found everywhere on *Andropogon scoparius*, to which it seems strictly confined. Mowing during the middle of June and again the first half of August, or burning during the fall or spring would serve to check this species.

DELTOCEPHALUS SYLVESTRIS N. SP.

(Pl. xxv, Fig. 4.)

Form and venation nearly of *D. cinereus*, but with a longer vertex. Form and size of the European *repletus*, but differing in venation. Length, 3.50 mm. Width, 1 mm.

Vertex twice as long on the middle as next eye, longer than the pronotum, nearly twice longer than wide, acutely pointed; front long, narrow, much longer than wide, hardly half wider at ocelli than on clypeus; clypeus strong; loræ broad, prominent. Pronotum long, more than half as long as wide; posterior angles strong; elytra long, narrow, nervures distinct, venation as in *debilis*, outer anteapical long, narrow, distinctly more than half the length of the middle one.

Color: Greenish, marked with pale fuscous and brown; vertex light green with two more or less distinct brownish stripes; pronotum green, light margined; elytra greenish, nervures light, more or less fuscous margined; never with a whitish cloud, as in *cinereus;* tergum black at base; front fuscous with light arcs, clypeus light; loræ and genæ with fuscous and light margins.

Genitalia: Ultimate ventral segment of the female light colored, long, slightly narrowing posteriorly; the middle third abruptly produced one-half its width, produced part longer at the margin, not notched or rounded as in *cinereus*, distinctly black; male valve broadly triangular, apex pointed; plates three times the length of the valve, broad at base, concavely pointed, tip divergent, a dark line near the outer margin widened to a spot near the middle.

This is a widely distributed species, having been received from Maryland and Kansas. Specimens are in the VanDuzee collection from Ontario, and it has been taken at Ames for a number of years. It occurs only on blue grass in wooded areas, where it may be found in immense numbers. It was first observed this season, June 4th, in considerable numbers, and from then on nearly through July. Observations were not made again until September, when it was found as thick as ever. The larvæ were not successfully separated from those of other species occurring in the same location and so no separation into broods can be made at present.

DELTOCEPHALUS CINEREUS VAN D.

Trans. Am. Ent. Soc., XIX, p. 304, 1892.

This is a neat, compact little species, slightly stouter in appearance than *melscheimeri* and of a distinctly fuscous or cinereus cast.

The vertex is twice as long on the middle as next eye, length and width about equal, tip acutely produced, pale fulvous brown, with narrow margins and a broader median line enclosing a black impressed line, white; elytra with cinereus nervures, heavily margined with fuscous.

Genitalia: Ultimate ventral segment of female slightly rounding behind, distinctly notched in the center, slightly arcuated and deeply black either side of the notch; male valve produced, sides emarginated, apex obtusely rounding; plates more than twice the length of the valve, convexly pointed.

Specimens of this species have been received only from California, from which place it was originally described. This species and the preceding one are closely allied, but may be readily separated by the length of the vertex and the female genitalia, as well as by the difference in color.

DELTOCEPHALUS AURATUS G. & B.

Hemiptera of Colorado, p. 85.

The female described under this name by Gillette and Baker (Hemiptera of Colorado, p. 85) was evidently a freshly issued example of *melscheimeri* as may be readily determined by comparing his description and drawing with the descriptions and drawings of *D. affinis* on the preceding page of same work, *affinis* being also a synonym of *melscheimeri* as proved by examination of typical specimens of both sexes. The male *auratus*, however, is a very distinct species, with a more roundingly margined vertex, and narrower front and clypeus.

The elytra are very long, overlapping, with a distinct appendix, the center anteapical cell greatly elongate, posteriorly extending much beyond the adjacent cells; valve broad, short, about equaling the ultimate segment; plate broad at base, about three times the length of the valve, slightly narrowing, with straight margins to the broad truncate apex, styles bristle-like, exceeding the plates; pygofers with numerous strong spines below. Color: face and vertex orange red, pronotum and elytra yellow, sometimes with a reddish cast; venter and genitalia light yellow, plates narrowly black-tipped.

DELTOCEPHALUS SIGNATIFRONS VAN D.

(Plate xxv, Fig. 1.)

Trans. Am. Ent. Soc., XIX, p. 305, 1892.
D. sexmaculatus G. & B., Hemip. Col. p. 88.*

This species, which was described from Colorado, and has been received from Maryland, occurs very commonly at Ames. It very closely resembles *inimicus* in form and color, but is readily recognized by its smaller size, and the absence of the dots of the former species.

The adult is 3.50 mm. long, narrow, elytra elongate, closely folded, giving it a very narrow appearance posteriorly. Vertex with six more or less distinctly marked bars, anterior pair smallest; the nervure of the elytra alternately fuscous and lighter; central anteapical cell elongate, constricted, rarely, if ever, divided.

Adults were taken rather commonly May 29th, and again June 4th, no more being taken until the last of August, when they were again swept in fair numbers, and from then on until September 10th, when the last one was taken. They were most abundant upon weedy places, roadsides, etc., where *Setaria* and *Panicum* abound. Considering the nature of the food-plant no economic measures need be suggested, unless it should be found to occur on millet or Hungarian grass.

DELTOCEPHALUS INIMICUS SAY.

(Plate xxiv, Fig. 3)

Jassus inimicus Say. Jour. Acad. Nat. Sci., IV, p. 305, 1831; Compl. Writings, II, p. 382, 1869.

This species is almost universally distributed throughout the northern part of the United States and into Canada. It has previously been reported west to the Rocky Mountains, and

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* On examination, the type specimen now in possession of Mr. E. P. VanDuzee proved to be an immature female of this species.

specimens are in hand from the state of Washington. It is readily recognized by its short vertex, elongate elytra, with the central anteapical cell divided, and the presence of six round black dots, a pair on the anterior margin of each, vertex, pronotum and scutellum; color, fuscous maculate. Ultimate ventral segment of the female narrowing posteriorly, margin twice indented, including a median obtuse tooth, outer angles rounding; male, ultimate segment slightly, angularly emaginate; valve short, obtusely angled; plates narrow, acutely pointed, equaling the pygofers.

Larvæ: broad, stout-bodied, with blunt, obtusely rounded heads; color yellow, with a broad, black margin behind the eyes.

The life-history of this species has already been given. Further observations during the past season confirm the idea of two broods as follows: Larvæ appearing about the first of May and maturing before the middle of June; adults from the first of June to the middle of July; the second brood of larvæ appearing before the middle of July and mostly matured by the third week in August, adults again from the second week in August on through September.

This species has a wide range in food habit and consequent variability in its life-history. The limits given above are for blue grass broods, where it is under nearly constant conditions and seems to be reasonably definite in its appearance. Its occurrence on annuals would be materially affected by the date of their appearance.

DELTOCEPHALUS WEEDI VAN D.

(Plate xxv, Fig. 2.)

Trans. Am. Ent. Soc., XIX, p. 306, 1892.

This pretty little species has also, probably, a very wide range, though only reported as yet for Mississippi. It also occurs at Ames.

Adults measuring about 3 mm., with a bluntly produced vertex, sides sharply concave, elytra slightly longer than the abdomen, flaring; central anteapical cell divided, color testaceous brown, with the anterior portion of the vertex and nervures of the elytra light; four dark points on anterior margin of vertex, front and venter dark; male plates short, together nearly circular in outline.

This species was taken at Ames in June, but no determination as to its life-history has been made.

DELTOCEPHALUS COMPACTUS N. SP.

(Pl. xxv, Fig. 3.)

Form and coloration similar to *weedi*, though with a shorter, blunter vertex and shorter elytra. Length, 2.75 mm. Width, 1.25 mm.

Vertex one-half longer on middle than next eye, slightly longer than broad, tip bluntly, slightly, convexly pointed; disc of the vertex slightly rounded; front inflated, broadest in the middle, rounding above and below; clypeus straight; genæ narrow, arising within the middle line of the eyes, scarcely angled; pronotum large, equaling vertex in length, posterior angles strong; elytra strong, convex, about equaling the abdomen in length, nervures strong, white, usually numerous strong reticulations between the outer claval nerve and the suture; central anteapical cell divided, posterior division usually circular in the shorter-winged specimens, resembling *ocellaris* in this respect.

Color: General appearance maculate brown; vertex light yellow with variable black and brown markings as follows: A black crescentiform interrupted band between the front margins of the eyes, a pair of approximate points near tip, and another pair just inside the black ocelli, dark brown: behind the crescentiform band on either side the median impressed black line, a circular light brown spot, which may be emphasized on the lateral margins when they appear as crescentiform dashes; pronotum dark reddish-brown, more or less maculate before; two faint wavy white lines across the disk: scutellum yellowish-brown, two dark spots on the disk; elytra brownish fuscous: nervures broadly white and fuscous; below, dark with white sutures, to black.

Genitalia: Ultimate ventral segment of female deeply, circularly emarginate behind, concealed except the acute lateral angles by a circular subhyaline membrane arising from the base of the segment and extending medially beyond the lateral angle. Male valve small, inflated, rounding posteriorly; plates broad at base, rapidly, concavely narrowing to the long attenuate points, exceeding the pygofers. Described from forty-seven specimens.

This species has been received from the state of Washington and collected at Ames the past season.

Adults were first taken June 27th, when they were swept rather sparingly from two different patches of *Sporobolus hookeri*. They were taken from that time on till July 27th, and then again, probably of a different brood, August 15th and 19th, the latter ones, however, from a different locality, as the first two patches had been mown before that time.

DELTOCEPHALUS FLAVOCOSTATUS VAN D.

Canadian Entomologist, XXIV, p. 116, 1892.

This species was described from Mississippi; specimens are at hand from Ohio, North Carolina and Georgia, and it has been collected at Ames for a number of years and is recorded from

Washington, D. C. This appears to be an abundant form in the south and is apparently reaching its northern limit in Iowa, occurring, however, in marvelous abundance in hot sheltered locations and on southern exposures where the vegetation is short and the ground hot.

The adults are readily recognized by their deep, testaceous brown or black ground color, with a series of points on the anterior margin of the vertex, extending down to the antennal pits on either side and the two outer apical veinlets, white. The legs and a narrow marginal stripe on the basal half of the costa yellow. The head is short and rounding, the elytra long; central anteapical cell divided. Ultimate ventral segment of the female rounding posteriorly, slightly produced in the middle; male valve broad, convex, obtusely, concavely pointed; black, with a narrow yellow margin; plates two and a half times the length of the valve, bluntly pointed, margined with yellow bristles.

Larvæ: Quite as distinctly marked as the adult and are easily separated from any other form. They are two to two and one-half millimeters long, when full-grown, very stout built, head broad and short as in the adult. Color above a rich olive brown with three white bands as follows: One on the posterior margin of the thorax, complete in the larvæ but only visible between the wing-pads in the pupæ, a narrow interrupted one on the middle of the abdomen, and a broader one near the tip; each abdominal segment margined posteriorly with red, just in front of which there are four white dots arranged in longitudinal rows where not obscured by the white markings; eyes, area between the posterior bands and tip of abdomen darker, approaching black; beneath pale, with tip of abdomen and posterior tibiæ darker.

The adults were taken first June 20th, on a field that had just recently been seeded down and on which weeds were springing up very thickly. On July 27th the same spot was abounding in full-grown larvæ, pupæ and adults; the larvæ and pupæ disappearing within a week, adults continuing abundant from then on into and through October.

DELTOCEPHALUS NIGRIFRONS FORBES.

Cicadula nigrifrons Forbes. 14th Rept. Ill. State Ent., p. 67.
D. fusconervosus Van D Bull. Buffalo Soc. Nat. Sci., V, 207, 1894.
Thamnotettix perpunctata Van D. Bull. Buffalo Soc. N. Sci., V. No. 4, 1894.
Deltocephalus vanduzei Gillette and Baker. Hemiptera of Colorado, p. 90.

The specific limits and generic position of this species are very puzzling and have led to much confusion and synonomy

It has not been thought best at present to change the generic reference given by VanDuzee, although not included in the synopsis. With a more exact definition of the American genera which will be possible as our species are better known, this and some other aberrant forms of a generalized and plastic character may find their proper position.

It was first described by Forbes as a *Cicadula* from specimens with weak venation. VanDuzee received dark specimens of the green form from Mississippi and described them as *Thamnotettix perpunctata;* also describing a strong veined form from California with two cross nervures as, *D. fuscinervosus.* Gillette and Baker, from very dark forms, described *D. vanduzei.*

Larvæ and adults were found in immense numbers about the first of July. The larvæ had mostly all issued by the 10th, the adults continuing through the month; adults were again taken late in September and on into October. They were first found on a patch of plowed ground overgrown with *Panicum sanguinale* and *crus-galli*, and *Setaria viridis.* Here they occurred in immense numbers. They appeared to be more common on the annuals than on the perennials, but were taken almost everywhere, the later ones mainly from blue grass, the annuals having ripened and died. Professor Forbes described it as a serious pest of oats and in Insect Life, vol. VI., it was recorded as very abundant and destructive in lawn grass in Washington, D. C.

Where first found this season it occurred in two distinct forms about equally common, one with a single cross nervure and long elytra as in *Thamnotettix.* This form was light greenish-yellow with a light face, usually surrounded by an arch of dots above on the anterior margin of the vertex and two oblique dots on the disk of the vertex. The other form was cinereus, darker below, with shorter hyaline elytra, usually with two cross nervures and the central anteapical cell divided. These may probably be regarded as the equivalents of long and short-winged forms in other species, the smaller darker form with the more complex venation, being found almost everywhere, while the lighter form with the weak venation was only found in connection with the larvæ and apparently made little use of the wings.

The specific characters differ very little between the different forms, the variations in genitalia being similar to those in the long and short-winged forms of other species.

The vertex is short, obtusely angled, margins rounding to the front; a row of dark spots on the anterior margin extending down the face to the antennæ; the spots on the vertex more or less united and merged into bands connecting with the oblique bands on the disk; in the darker forms the front is roundingly inflated, the margins continuous with that of the clypeus; clypeus broadest below. The dark markings on the front heighten this appearance by rounding away from the sutures above on the front and expanding on the clypeus below. While these two forms are fairly constant they so intergrade in structure and color as to render separation impossible. Late specimens of the green form being often similarly marked and even more highly colored than early ones of the fuscous form: while early examples of the fuscous form often possess a venation even weaker than that of the green form and would be readily mistaken for *Cicadula*. Moreover, there is no distinction in the larvæ which produce them.

Larvæ: Form nearly that of *flavocostatus;* slightly narrower and more elongate, approaching those of *exitiosa*. More distinctly yellow than those of *D. ocellaris*, unmarked except two black dots on the margin of the vertex midway between the eye and the tip and a pair of oblique dashes on the disk of the vertex. The pupæ have in addition to these three spots on the anterior margin of the wing-pads and a number on the posterior half of the disk more or less definitely arranged in transverse rows.

A very widely distributed and abundant species. Specimens are at hand from New York, Maryland, Mississippi, Louisiana, Illinois, Iowa, Colorado and California.

DELTOCEPHALUS ARGENTEOLUS UHL.

Delocephalus argenteolus Uhler. Bull. U. S. Geol. and Geog. Surv., III, p. 473, 1877.
Athysanus curtipennis Gillette and Baker. Hemiptera of Colorado, p. 92.
Eutettix terebrans Gillette and Baker. Hemiptera of Colorado, p. 102.

The short winged forms of this species are very close to the European species of the genus *Doratura*.

D. MONTICOLA G. AND B.

Hemip. Col. p. 88.

This is a good Deltocephalus, but specimens came too late to allow of its insertion in the synopsis. It would follow *D. minimus*, which it closely resembles in size and coloration, but from which it is readily separated by the presence of a distinct median tooth on the last ventral segment of the female.

DELTOCEPHALUS MINUTUS VAN D.

Entom. Amer. VI, p. 96, 1890.

This species was described from a long-winged male, but it occurs in both long and short-winged forms very abundantly. The short-winged examples apparently fall into the genus *Doratura*.

DELTOCEPHALUS OSBORNI VAN D.

Trans. Am. Ent. Soc., XIX, p. 304, 1892.

This species should be placed in *Athysanus* and close to *extrusus*.

DELTOCEPHALUS SIMPLEX VAN D.

Trans. Am. Ent. Soc., XIX, p. 304, 1892.

This and the three following species should be placed in the genus *Thamnotettix.*

DELTOCEPHALUS COQUILLETII VAN D.

Entom. Amer., VI, p. 95, 1890.

D. CONCENTRICUS VAN D.

Deltocephalus concentricus VanDuzee. Bull. Buffalo Soc. Nat. Sci., V, p. 208.
Thamnotettix flavomarginata Gillette and Baker. Hemiptera of Colorado, p. 96.

D. BIMACULATUS G. AND B.

D. bimaculatus Hemiptera of Colorado, p. 86.
D. flavovirens. G. and B. Hemiptera of Colorado, p. 87.

DELTOCEPHALUS UNICOLOROUS G. AND B.

Hemiptera of Colorado, p. 89.

Probably an immature specimen of their *monticola.*

ATHYSANUS CURTISII FITCH.

Amblycephalus curtisii Fitch. Homop. N. Y. State Cab., p. 61, 1851.

This species is the best known and the most widely distributed member of the genus occurring throughout the Eastern States and Canada, and as far west as Michigan and Iowa at least, probably to the mountains. The adult is three and one-half millimeters in length by one and one-half broad, with the vertex scarcely longer than the width of the pronotum, obtusely convexly pointed; elytra exceeding the short ovipositor; color, vertex yellow, with large round spots before the middle, and tip black; face yellow, an oblique black band extending from either eye to the base of the clypeus, then prolonged narrowly to the tip, forming a Y-shaped mark; the pronotum yellowish-green, with a black crescent, anteriorly; elytra dark, nervures yellowish-green.

Larvæ stout, with a large, convexly conical head. Of a deep yellow color, with eyes and antennæ dark. The body is covered with long stout hairs.

This species is confined strictly to blue grass in meadows and wooded pastures, where it rivals *D. sayi* in abundance. First collected this season, June 17th, as adults in abundance; the larvæ were found during July, becoming full grown and issuing as adults by the end of the month. Another brood of larvæ matured during September, the adults continuing through the rest of the season, becoming scarce by the last of October, when a dissected female showed one fully developed egg, the rest probably deposited.

ATHYSANUS BICOLOR VAN D.

Canadian Entomologist, XXIV, p. 114, 1892.

This species was described from Kansas and Mississippi, and had been reported from Iowa under the name *virgulatus Uhl* (a MSS. name). The adults have nearly the same form and size as the preceding species; the vertex is more pointed and the attenuate ovipositor extends beyond the elytra.

In color the females are yellowish green, with two large coalescent spots on the vertex, both margins of the pronotum, the entire claval suture and the tip of the wing black; below, all light. The males have the whole point of the vertex the sutural margin and an oblique band from the anal cell to the center of the costal margin black. Below all black except a band across the middle of the face. It can be readily separated from *curtisii* by the absence of the Y on the face, and the fact that the yellowish-green of the elytra is not confined to the nerves.

The larvæ are very light yellow, sometimes almost white, and the hairs are much smaller and finer than those of *curtisii*, which, otherwise, they closely resemble. They were first taken June 16th, when the first adults of a brood were issuing; larvæ remaining abundant until the end of the month. The adults were very thick until well into July, disappearing before the end; appearing again toward the end of August and through September. They were thickest upon a patch of *Andropogon scoparius*, where it was nearly free from other grasses.

ATHYSANUS OBTUTUS VAN D.

(Plate xxi, Fig. 2)

Canadian Entomologist, XXIV, pp. 115, 156, 1892.

This species was described from Mississippi, and has been received from Kansas and taken at Ames prior to this season. The adults have almost exactly the form and size of *bicolor*, but are readily distinguished by their color. The vertex is lemon yellow, with two round spots just before the middle, and two small, oblique dashes near the base, darker. The remainder of the body is testaceous. Apical cells of the elytra hyaline, enclosing veinlets dark.

The larvæ are light yellow when small, but gradually darken to a chocolate brown in pupa, when they resemble the adults in form. The adults have been taken the last week in April, rather commonly, indicating an adult hibernation, the larvæ appearing in May, maturing the middle of June; the adults remaining through June and the greater part of July. Full-grown larvæ were found toward the latter part of July and again before the middle of September; adults common throughout the season. This would indicate three broods during the season, the third one hibernating as adults, though the larvæ found in July may have been belated ones of the first brood.

The food plant is *Andropogon scoparius*, and it was not until late in the season that the larvæ of *D. oculatus*, *Athysanus bicolor* and the smaller light ones of *obtutus* could be distinguished. Many confusing records interfere with the accurate determination of the later broods.

ATHYSANUS COMMA VAN D.

Canadian Entomologist, XXIV, 114, 1892.

This species was described from Iowa and has been received from Colorado. The adults are five millimeters long by nearly two broad, with a short flat vertex, color creamy white with four square spots on margin of vertex, two round ones near its base, four stripes on the pronotum, the claval suture black. A broad stripe within and parallel to the costal margin, reaching and covering the apical veinlets, curving back to meet a black stripe on the disk, cinnamon brown.

Larvæ have been referred to this species only with some doubt, and will not be described.

Adults were taken from May 27th until July 9th, most abundantly about the third week in June. They were again taken in August, however, not so abundantly. The spring brood was taken from *Elymus canadensis*, but no fall brood could be found on this plant, those taken in August being taken from *Elymus striatus*. On August 11th three partly grown larvæ resembling the adult except that they had only three stripes instead of four, were beaten from the heads of *Elymus canadensis*. This species is strictly confined to the *Elymus* as a host plant, but might damage other grasses near where it was abundant. Cutting the *Elymus* the first of July would destroy the eggs for the second brood.

ATHYSANUS COLON N SP.

(Pl. xxvi, Fig. 3.)

Form and general appearance nearly as in *comma*, clear, creamy white with dark stripe, occurs in two wing lengths. Length of female, 5 mm.; male, 4.25 mm. Width on costa, 2.25 mm.

Vertex nearly flat, one-half wider than long, shorter than pronotum, obtusely angled before, margin obtuse; front one-third longer than wide, width on clypeus more than half that at ocelli; clypeus narrow, nearly parallel margined; loræ large, wider than clypeus: pronotum more than three times wider than long, obtusely rounding before; side margins, one-half the length of the eyes; elytra occurring in two lengths, a short form in which the apical cells are minute, reaching only to the penultimate segment, this usually associated with rudimentary wings, the long-winged form with fully developed apical cells elytra exceeding the abdomen and associated with fully developed wings; venation simple, inner branch of first sector forked near its middle, making one more anteapical cell than in *comma;* four terminal and two costal cells.

Color: Clear, creamy white with testaceous and black markings as follows: Four quadrate spots on the anterior margin of vertex, the outer pair between the eyes and ocelli, two large round spots near the base of the vertex and a smaller irregular pair on the disk midway between these and the inner marginal pair, black; a small black spot under the base of the antennæ, four equidistant dark brown or black stripes on the pronotum, the inner pair extending across the scutellum; a small dash behind the eye and a stripe just under the lateral margin of pronotum, black: elytra with eight brown stripes, a complete longitudical stripe just outside the first sector and another next the claval suture, a narrow stripe between the branches of the first sector, a shorter one between branches of its inner fork, a broadly interrupted one between the first and second sectors, a complete median stripe on the clavus, one on the outer, apical half and another on the inner, basal half. The apical cells and the apex of the anteapicals, fuscous margined. Tergum with four black lines posteriorly; pygofers with two round black spots above; connexivum broadly margined on the outside, narrowly on the inside, with black; legs lined and spotted with black.

Genitalia: Ultimate ventral segment of the female with the posterior margin angularly excavated; apex of excavation truncate, sharply notched, black; lateral angles acute; male valve narrow, apex rounding, one-half longer than the ultimate segment; plates slightly broader than valve at base, narrowing to the middle, then parallel margined to the broad truncate apex, twice the length of the value, equaling the pygofers; pygofers with the side margins compressed below, an oblique black mark just back of the margin beneath. Described from numerous specimens collected at Ames, Iowa.

Readily separated from *comma* by the additional fork of the first sector, the spots on the disk of the vertex and the number of stripes on the elytra Superficially it so closely resembles that species that hitherto specimens have been confused with those of that species.

Larvæ very broad, stout forms; head large, resembling the adult; vertex slightly more pointed; color creamy white, with four brown stripes as follows: An inner parallel pair arising from distinct spots on the apical margin of the vertex and extending to the tip of the abdomen on either side, a pair just inside the margin of the body arising behind the eyes and terminating before the last abdominal segment.

Larvæ were taken from *Stipa spartea* June 4th, and issued in the cages on the 6th. They were found up to June 10th, when they had all issued. Adults were taken through June and late into July, but no second brood appeared, probably owing to the ground having been mowed over June 27th, thus destroying the eggs.

This species was never taken away from *Stipa*, but occurred in such abundance that it over-ran the adjacent grasses.

ATHYSANUS MAGNUS N. SP.

(Pl. xxvi, Fig. 2.)

Form similar to *Athysanus argentatus* Fab., but still larger. The largest species in the genus. Ashy, with transverse light bands on head and pronotum. Length of female, 8 to 9 mm.; width of eyes, 2.50 to 3 mm.; male smaller.

Head wider than the pronotum, short, scarcely exceeding half its length; anterior and posterior margins nearly parallel; ocelli distant from eyes; vertex four times wider than long; front four times as wide at ocelli as on clypeus, widest at antennæ; antennæ small, short, inserted under a small ledge; clypeus spatulate; genæ broad; pronotum nearly three times wider than long; elytra strong, broadest at base, without an appendix, two ante-apical cells nearly equal in size, four terminal cells and one costal cell.

Color: Vertex light yellow with an arcuated line between the ocelli; face finely irrorate with brown, becoming darker below; antennal pit black; pronotum fuscous, margins darker, a broad light yellow transverse band just before the posterior margin; elytra, nervures brown, margined with light, disk of the cells finely irrorate with fuscous, costal margin broadly cream colored; tergum with a dark median stripe; venter brownish; femora mottled with brown; tibiæ black lined.

Genitalia: Ultimate ventral segment of female slightly longer than penultimate, strongly notched in middle, broadly, rather acutely lobed either side, lateral angles rounding, slightly exceeding median lobes; male valve small, triangular, one-half the length and two-thirds the width of the ultimate segment; plates together long triangular, about one-half longer than breadth at base, margins thickened and fringed with stout hairs. Described from twenty specimens.

It has been received from Texas, Kansas, Nebraska, Dakota, and northwest Iowa, also collected sparingly at Ames, from *Spartina cynosuroides* exclusively.

CHLOROTETTIX SPATULATA N. SP.

(Plate xxvi, Fig. 4.)

Intermediate, in form and size between *unicolor* and *galbarata* but more distinctly green than in either species. Length, 7 mm; width, 1.75 mm.

Vertex two and one-half times wider than long, margins parallel or slightly longer on middle than next eye, anterior margin broadly rounding to the face; front narrowing rapidly to the small clypeus; genæ broad, rounding below; pronotum one-half longer than vertex, emarginate behind: side margins short, not strongly carinated: elytra broader than in *lusoria*, venation similar, weak.

Color: Green; elytra sub-hyaline sometimes pallid.

Genitalia: ultimate ventral segment of female very long on lateral margin, posterior margin produced, broadly notched, more than one-half the depth of the segment, apex of notch with a spatulate process two and one-half times as long as breadth at base, two-thirds the length of the notch, lateral margin of segment rounding to the acute lateral angles. Male valve appearing as a narrow margin to the ultimate segment: plates sloping, broad at base, convexly rounding, acutely pointed, about equaling the pygofers.

Described from forty-two examples collected at Ames, Iowa. It has also been received from Colorado (Gillette) and Nebraska (Bruner).

THAMNOTETTIX LUSORIA N. SP.

Form and general appearance of *Chlorotettix tergatus*, but with a sharper vertex and more general reddish cast. Length, 7 to 8 mm; width, 2 mm.

Vertex slightly convex, one-half longer on middle than next eye, twice wider than long, margins broadly rounded, but with a distinct, slightly produced tip; front one-third longer than wide, three times wider at ocelli than on clypeus; pronotum long, front margin strongly rounding, posterior margin nearly truncate, sides long, carinated; scutellum with a quadrate light area on the disk, including two dark spots; elytra two and one-half times longer than wide, much exceeding the abdomen, without an appendix, first anteapical long, parallel margined.

Color: Similar to *Chlorotettix necopina;* vertex olive brown with a faint crescentiform band before the eyes; pronotum fulvous brown: elytra sub-hyaline with a distinct reddish tinge, nervures light; below tawny yellowish.

Genitalia: Ultimate ventral segment of female long, slightly emarginate behind, with a strong, angularly pointed, dark margined median tooth about equalling the acutely rounding lateral angles: pygofers long and narrow, nearly half the length of the abdomen: male valve very short and broad, less than half the length of the ultimate segment; plates strong, flat, one-half longer than breath at base, outer margins thickened, sparsely hairy, points strongly divergent, usually a fuscous line on either side arising from a spot at the base.

Described from eight males and ten females all collected at Ames, Iowa.

THAMNOTETTIX LONGULA G. AND B.

Hemiptera of Colorado, p. 97.

Form of *lusoria* but much smaller; coloration similar to *T. tenuis* Germar. Length, 5 to 6 mm; width, 1.40 mm.

Vertex twice wider than long, slightly longer on middle than at eye, margin rounding, tip slightly produced, front twice wider at ocelli than on clypeus, base of suture rounding; clypeus broadest at the tip; pronotum one-half longer than vertex, slightly concave behind lateral margins, short, rounding; elytra as in *lusoria*, central anteapical cell constricted.

Color: Fulvous maculate with dark chestnut, vertex light fulvous, ocelli white, connected by a light line which runs forward on the tip; a round spot on either side at the base of vertex and a median line, extending forward to the white transverse line, chestnut; front fulvous with dark sutures and abbreviated arcs along the lateral margins dark chestnut; remainder of the face pale yellow with dark figure; pronotum fulvous with the anterior margin maculate with chestnut and bright yellow; scutellum fulvous with a quadrate light-yellow area on disk containing two round chestnut spots; elytral nervures light, chestnut-margined.

Genitalia: Ultimate ventral segment of female twice wider than long, posterior margin slightly notched, much depressed in the middle, giving it the appearance of being angularly excavated; pygofers very narrow, long, strongly spined; male valve broad, about equaling the ultimate segment in length; plates broad at base, convexly rounding, with stout spines to the nearly parallel margined attenuate, unarmed tips.

Described from two males and three females. Collected at Ames, Iowa. One specimen received from Douglass county, Kan. (Kellogg).

[NOTE—Since writing this as the description of a new species, an examination of the Gillette and Baker type has enabled us to refer our specimens to their species. As their description was from male alone, we have thought best to allow our description, which covers both sexes, to stand as sent to printer.]

THAMNOTETTIX PERSPICILLATA N. SP.

Form of *longula* nearly, but much smaller; elytra hyaline with numerous black spots; length, 3.50 to 4 mm.; width, .9 mm.

Vertex scarcely wider at base than long, little longer at middle than on eye, evenly rounding to front: front inflated, long, roundingly narrowing to the small clypeus; clypeus broadening at apex; genæ distinctly angled, nearly straight margined below; pronotum slightly longer than vertex, lateral margins obsolete, posterior angles approaching right angles; elytral venation strong, similar to *longula*, appendix distinct.

Color: Pearl gray; ocelli large, white; vertex light cream color, washed with orange: two approximate oblique dashes on the tip, continuing as lines to the ocelli, and a round spot just behind either ocellus, black; a double median light brown line deflected to either side, just before the middle, forming two chestnut crescents on the disk; basal half of the disk on either side, with a large fulvous ring, enclosing a white spot; pronotum gray, with six white-margined, black spots, arranged in pairs on the anterior margin; scutellum pale yellow, with about five black spots; elytra milky, sub-hyaline, with a fulvous iridescence; nine black spots on each elytron, as follows: Three equidistant small spots on the sutural margin, a spot on the base of clavus, one on the claval suture one-third the distance from the base to apex, a spot on each of the two apical veinlets, a large spot on the disk of corium between the first and second sectors, and another large one on the sutural margin before the median small dot; front gray, with a median white line, and white arcs, the upper pair forming an arch above the rest, nearly transverse: rest of face light, a black spot under each ocellus and one on either side of the antennal base; tergum light yellow, disk clouded with dark, a row of black spots on either margin; connexivum and venter each with a row of spots next the suture; legs maculate.

Genitalia: Ultimate ventral segment of the female one-half longer on lateral margin than penultimate, posterior margin angularly produced. one-third the length of segment; male valve broad and short; plates broad at base, narrowing rapidly to beyond the middle, with produced attenuate points, one-half longer than width at base, margin stout, fringed with long curved hairs, an oblique black mark on either side at base.

Described from two females and four males, Ames, Iowa.

PHLEPSIUS ALTUS N. SP.

(Plate xxvi, Fig. 5.)

Form similar to *superbus*, short and stout, elytra somewhat flaring: head short and broad, similar to *truncatus*. Dark fulvous brown; length, 5.50 mm; width, 2 mm.

Head slightly wider than the pronotum: vertex scarcely one-third longer at middle than next eye, three times wider than long, less than one-half the length of the pronotum, rounding to the front with a faint carina, as in *cinereus;* front three times wider above than on clypeus, twice longer than wide, slightly expanded below; loræ large, nearly twice wider than clypeus · pronotum two and one-half times wider than long, lateral margins very short, less than one-half the length of the vertex, posterior angle well marked; elytra broad, about twice longer than wide, without an appendix, veins on clavus but slightly approaching each other in the middle, seldom with a cross nervure central apical cell no longer than breadth on margin.

Color: Dark fulvous; pronotum and scutellum soiled yellowish-white; irrorate with fulvous brown, disk of pronotum usually clouded with fuscous; vertex and face yellow, finely irrorate, almost clouded with fulvous, usually without pattern of marking except the white margined ocelli and a white spot on the upper angle of the loræ; elytra pearly white, washed with yellowish and irrorate with dark fulvous, except for numerous spots, venter yellowish-brown; legs brown with dark markings.

Genitalia: Ultimate ventral segment of female longer than penultimate; middle half of posterior margin truncate, with a deep median slit and a minute lobate indenture on either side; lateral half of either side produced as a semi-circular lobe against the side of the pygofers; male valve large, longer than ultimate segment, broadly lobate, margin indented on either side of the apex; plate broader than the valve, rapidly, convexly narrowing to the middle, then slightly produced, roundingly pointed: ventral surface convex, disk apparently raised, lighter. Described from sixty specimens.

This species has been collected at Ames and Little Rock, Iowa, and specimens are at hand from West Point, Neb.

(Bruner). It belongs to the group of Phlepsids with the head as broad as the pronotum, but may be readily separated from all the other species of the group by its stouter form and flaring elytra, as well as by the genitalia.

PHLEPSIUS MAJESTUS N. SP.

(Plate xxvi, Fig. 6.)

Form of *spatulatus*, nearly, but larger, with much longer elytra; color distinctly reddish brown with copper reflections; length, 9 to 10 mm.; width on costa, 3 to 3.50 mm.

Head much narrower than the pronotum: vertex, flat, twice wider than long, one-fourth longer on middle than next to eye; front much narrower than in *spatulatus*, very nearly twice longer than wide, basal suture obsolete; clypeus broadly spatulate, twice wider at apex than on middle of loræ; pronotum fully twice longer than vertex, anterior margin strongly produced, lateral margin as long as the vertex, carinate, strongly oblique; elytra long and narrow, much exceeding the abdomen, veins on clavus converging, united by a cross nervure, apical veinlets curved, central apical cell one-half longer than breadth at apex: a number of extra veinlets from the first anteapical cell to the costal margin, reticulations very strong, appearing almost as nervures; closely mimicing the appearance of *Gypona octo-lineata* in this respect.

Color: Cuprescent; vertex light yellow, with two approximate dots near its tip; a broad black band between anterior half of eyes, straight-margined in front, excavated either side of the middle, behind, and often interrupted medially with brown, and a spot on either side of base near eye brown; face pale yellowish, sutures and about nine abreviated arcs fuscous: pronotum fulvous with lateral margins, a Y-shaped mark behind either eye and numerous minute maculations on the disk, creamy white; scutellum fulvous yellow, disk with two brown spots, margin with alternate dark and light markings; elytra yellowish white, nervures and coarser irrorations, fulvous brown: tergum and venter yellowish, dark on the disk; legs yellow; anterior coxæ with large brown spots; femora and hind tibiæ with a series of minute, black dots.

Genitalia: Ultimate ventral segment of the female broader than in *spatulatus*, lateral margins nearly straight, angles rounding, posterior margins roundingly emarginate either side of two large, divergent, acute points, which extend beyond the lateral angles, and are separated by a broad deep notch extending over half way to the base: male valve roundingly produced apex broad, nearly equaling the ultimate segment in length; plates rather narrow, elongate, three times the length of the ultimate segment. Described from five females and four males.

Two females of this species were included by Mr. Van Duzee in his description of *spatulatus* remarking, however, that they were larger and fulvous brown in color and might easily be mistaken for Gyponas. A larger series of both species show them to be decidedly distinct. *Spatulatus* is much smaller, nearly cinereus in color and has much finer irrorations on the elytra. Specimens are at hand only from Texas, Arizona and California, indicating a southwestern distribution: *majestus* is much larger, fulvous red with coppery reflections, being the largest and most highly colored species of the genus. It closely mimics *Gypona scarlatina* in size and appearance, and occurs in similar situations. Specimens have been collected at Ames, and one specimen received from Philadelphia and another from Mississippi. None have been received from the known habitat of *spatulatus* and it would seem to be an eastern form although its scarcity in collections may be due to the fact that it is extremely difficult to catch.

PHLEPSIUS DECORUS N. SP.

(Plate xxvi, Fig. 7.)

Form very broad and short; elytra flaring; color milk-white, sparsely irrorated with deep fuscous or black giving it a dark, maculate appearance with scarcely a trace of fulvous. Length, 6 mm; width, on center of costa, 2.50 to 3 mm.

Head narrower than the pronotum; vertex flat, similar to *majestus*, twice wider than long, slightly longer on middle than next eye, acutely angled with the front; front broad, flat, sides straight, twice wider above than at apex, about one-third longer than wide, basal suture well marked; genæ broad, outer angle distinct; pronotum short, about half longer than the vertex; lateral margin oblique, carinate, two-thirds the length of the vertex, posterior angle well marked; elytra short, scarcely twice longer than wide, veins on clavus nearly touching in the middle, united by a short cross nervure, central apical cell half longer than wide.

Color: Vertex pearly white with numerous fuscous irrorations which merge into an irregular transverse band between the eyes; face creamy white, irrorate with fuscous, the arcs nearly obliterated; clypeus fuscous on suture, two slightly divergent lines on disk; pronotum yellowish with fine fuscous irrorations, two crescentiform dashes near the anterior margin, black; scutellum soiled yellowish, two fuscous spots on the disk; elytra milk-white, nervures black, claval suture and margins of the nervures yellowish brown, irrorations fuscous to black, more or less definitely arranged in three transverse bands and a series of spots on the costal margin toward the apex; scutellar and sutural margins broadly white.

Genitalia: Ultimate ventral segment of female very broad and short, over four times wider than long, nearly truncate behind with a broad deep notch, extending half way to the base. Male: valve small triangular; plates broad, short and convex, scarcely half longer than ultimate segment, parallel margined at base, bluntly angularly pointed.

Described from one male from Lincoln, Neb. (Bruner), and one female collected at Ames, Iowa.

This and the preceding species belong to the section of the genus in which the head is narrower than the pronotum and which includes *spatulatus*, *ovatus*, *exultus*, *superbus* and *neomexicanus*. They may be readily separated from the other members of the group by their more definite colors as well as by their distinct genitalia.

ADDITIONS TO THE FORMER LISTS OF IOWA SPECIES.

The following list embraces the additions, not included in the preceding notes, that have been made to the Iowa fauna during the past year or two.

HETEROPTERA.

Perillus exaptus Say. This handsome species has been taken at Little Rock, Lyon county, and Ames.

Podisus serieventris Uhl. Ames.

Oebalus pugnax Fab. This peculiar southern form was taken at Ames in some numbers the past summer.

Liodema belfragii Stal. A single specimen of this species has been taken by Mr. Ball at Little Rock, Lyon county.

Alydus conspersus Montandon. This name should replace that of *Alydus ater* in previous list.

Neides muticus Uhl. Ames, Iowa.

Belonochilus numenius Say. Ames; not commom.

Ilnacora divisa Reut. Ames.

Phytocoris colon Say. Ames.

Coriscus punctipes Reut. Ames; common.

Coriscus inscriptus Kby. Ames.

Pygolampis sericea Stal. Ames; rare.

Barce annulipes Stal. Iowa City and Ames.

Ranatra quadridentata Stal. Common; *fusca* is less common if, indeed, it occurs in the state.

HOMOPTERA.

Ulopa canadensis Van D. Ames; rare.

Bythoscopus distinctus Van D. Common on Hackberry at Ames.

Idiocerus cratægi Van D. Ames.

Agallia novella Say. Ames.

Pachyopsis robustus Uhl. Not common.

Oncometopia limbata Say. Little Rock and Hampton.

Tettigonia similis Woodworth. Common at Ames.

Diedrocephala angulifera Walk. Ames and LeClaire.

Gypona scarlatina Fitch. Ames.

Gypona albimarginata Woodworth. Ames.

Strongylocephalus agrestis Fall. Ames; rare.

Paramesus vitellinus Fitch. Ames.

Athysanus extrusus Van D. Ames.

Doratura argenteola Uhl.

Doratura minuta Van D. Ames.

Athysanus plutonius Van D. Ames.

Athysanus gammaroides Van D. Ames; not common.

Athysanus striatulus Fall. Ames.

Eutettix lurida Van D. Ames.

Eutettix southwicki Van D. Ames.

Eutettix johnsoni Van D. Ames; rare.

Phlepsius humidus Van D. Ames.

Phlepsius incisus Van D. Ames.

Phlepsius truncatus Van D. Ames.

Phlepsius cinereus Van D. Ames. Fairly common in 1896, but probably a southern form.

Phlepsius fuscipennis Van D. Ames; not common.

Scaphoideus intricatus Uhl. Ames; rare.

Scaphoideus luteolus Van D. Ames.

Scaphoideus lobatus Van D. Ames.

Scaphoideus scalaris Van D. Ames. Hitherto credited only to California.

Scaphoideus auronitens Prov. Ames.

Thamnotettix inornata Van D. Ames. Hitherto recorded for New York only.

Thamnotettix longiseta Van D. Ames. Originally described from Colorado.

Thamnotettix smithi Van D. Ames. Hitherto recorded only from New Jersey.

Thamnotettix fitchi Van D. Ames.

Chlorotettix galbanata Van D. Ames; common.

Gnathodes abdominalis Van D. Ames.

Gnathodes impictus Van D. Ames.

Cicadula variata Fall. Ames.

Cicadula punctifrons Fall. Ames.

Kybos smaragdula Fall. Ames.

Dicraneura abnormis Walsh. Ames.

Dicraneura flavipennis Fab. Ames; common.

Empoasca obtusa Walsh. Ames.

Clastoptera xanthocephala Germ. Ames.

Monecphora bicincta Say. Ames.

Stenocranus croceus Van D. Ames.

Liburnia vittatifrons Uhl. Not common except in particular locations.

Scolops grossus Uhl. Common in 1896.

Vanduzea arcuata Godg. Occurs on locust and usually very abundant where found, Ames and Albia.

Telamona godingi Van D. Ames. Not common.

Stictocephala lutea Walk. Common. Confused with inermis.

Publilia modesta Uhl.

Diaspis rosæ. Muscatine. Very abundant and destructive to roses and other garden shrubs. A serious pest where it occurs.

Hæmatopinus pedalis Osb. An interesting parasite of sheep, occurring on the feet and lower part of legs, but not on wooly parts of the body.

Euhæmatopinus abnormis Osb. A very peculiar parasite of the common mole *Scalops argentatus.* The femora of the hind legs bear disk-like processes which evidently oppose the tibiæ of the middle legs as a clasping organ. I have described it in a bulletin on "The Insects Affecting Domestic Animals," recently issued by the Div. Ent. U. S. Dep. Agriculture.

EXPLANATION OF PLATES.*

PLATE XIX.

Fig. 1. *Xerophloea viridis* Fab. *a*, female, dorsal view; *b*, face; *c*, lateral view; *d*, larva; *e*, male; *f*, female, genitalia.

Fig. 2. *Xestocephalus coronatus* n. sp. female, dorsal view.

Fig. 3. *Euacanthus acuminatus* Fab. *a*, female; *b*, larva, dorsal views.

PLATE XX.

Fig. 1. *Dorycephalus platyrhynchus* Osb. *a*, female; *b*, male, dorsal view; *c*, face; *d*, female, *e*, male genitalia; *f*, eggs in grass stem; *g*, eggs enlarged; *h*, eggs with larva nearly ready to hatch; *i*, newly hatched larva; *j*, larva after first moult; *k*, after second moult; *l*, pupa.

Fig. 2. *Hecalus lineatus* Uhl. *a*, female; *b*, male, *c*, larva, dorsal view; *d*, face; *e*, female, *f*, male genitalia.

PLATE XXI.

Fig. 1. *Parabolocratus viridis* Uhl. *a*, male; *b*, female; *c*, mature larva, dorsal views; *d*, female; *e*, male genitalia; *f*, eggs in grass stem; *g*, eggs enlarged; *h*, single egg much enlarged, showing young; *i*, larva newly hatched; *j*, after first moult.

Fig. 2. *Athysanus obtutus* Van D. *a*, ventral; *b*, lateral; *c*, dorsal view of female; *d*, female; *e*, male, genitalia; *f*, pupa; *g*, eggs much enlarged; *i*, eggs in place under grass leaf sheath.

PLATE XXII.

Fig. 1. *Deltocephalus reflexus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female; *e*, male, genitalia; *f*, wing; *g*, larva; *h*, face of larva.

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* All figures here given are photo-reproductions of drawings made by Miss Charlotte M. King, under the personal direction and supervision of the authors.

In plates xxii to xxv four species are shown on each plate, each one occupying one-fourth of the plate, and being lettered independently, and in nearly every case the letters correspond for each species, notice of which will avoid any possible confusion in reference to figures.

Fig. 2. *D. inflatus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female; *e*, male, genitalia; *f*, wing; *g*, abdomen of male, lateral view.

Fig. 3. *D. pectinatus* *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, male, *e*, female, genitalia; *f*, wing; *g*, larva.

Fig. 4. *D. abbreviatus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

PLATE XXIII.

Fig 1. *D. albidus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

Fig. 2. *D. sayi* Fh. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

Fig. 3. *D. configuratus* Uh. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

Fig. 4. *D. oculatus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

PLATE XXIV.

Fig. 1. *D. melscheimeri* Fh. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

Fig. 2. *D. debilis* Uh. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, lateral view of head.

Fig. 3. *D. inimicus* Say. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female. *e*, male, genitalia; *f*, wing; *g*, larva.

Fig. 4. *D. minimus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing; *g*, larva.

PLATE XXV.

Fig. 1. *D. signatifrons* Van D, *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing.

Fig. 2. *D. weedi* Van D. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing.

Fig. 3. *D compactus* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum: *d*, female, *e*, male genitalia; *f*, wing.

Fig. 4. *D. sylvestris* n. sp. *a*, dorsal view; *b*, face; *c*, vertex and pronotum; *d*, female, *e*, male, genitalia; *f*, wing.

PLATE XXVI.

Fig. 1. *Platymetopius cinereus* n. sp. dorsal view 1*a* larva.

Fig. 2. *Athysanus magnus* n. sp. dorsal view.

Fig. 3. *Athysanus colon* n. sp. dorsal view, 3*a* wing, 3*b* larva.

Fig. 4. *Chlorotettix spatulata* n. sp. dorsal view 4*a* female, ultimate ventral segment.

Fig. 5. *Phlepsius altus* n. sp. female ultimate ventral segment 5*a* male genitalia.

Fig. 6. *Phlepsius majestus* n. sp. ultimate ventral segment of female, 6*a* genitalia of male.

Fig 7. *Phlepsius decorus* n. sp. ultimate ventral segment of female, 7*a* genitalia of male.

NOTES ON THE ORTHOPTEROUS FAUNA OF IOWA.

BY E. D. BALL.

As a family the Orthoptera have long been regarded as among the most injurious insects of the state. Every addition, therefore, to a list of species adds one more to the number of possible depredators of a given locality. On the other hand, every fact in regard to distribution, life-history or food habits of a species, added to the general knowledge, aids in formulating successful methods of treatment for the particular species.

In working over the additional material accumulated, and in rearranging the Orthopterous collection of the Iowa Agricultural college during the early part of the year several additional species were found; these, with some material collected in Lyon and Mahaska counties several years ago, together with the collecting of the present season at Ames, have furnished the basis for an addition of some 30 species to the list published by Professor Osborn in the proceedings of this academy for 1891.

Owing to the fact that there has been considerable revision in nomenclature and synonomy since the publication of the former list, thus rendering necessary a number of changes, and further that a majority of the species would be included in the notes, it has been thought best to make the list of species complete, although in a number of cases nothing additional can be given.

The arrangement of families in the list is purely arbitrary, for as yet there seems to be no satisfactory arrangement based upon philogenetic deductions. Within the families the ordinary arrangement has been adopted except where there has been recently suggested changes. In the groups Tettiginæ and Tryxalinæ, Prof. A. P. Morse's recent revision has been followed and in the Tettiginæ he has kindly verified all the determinations. To Professor Scudder I am indebted for the determination of the Ceuthophilus listed. While to Professor Lawrence Bruner I am under obligations for the determination of a number of species and the verification of the greater portion of the remainder of the list.

ORDER ORTHOPTERA.

Fam. FORFICULIDÆ—Earwigs.

Labia minor Linn, A few specimens taken each year.

Fam. BLATTIDÆ—Cockroaches

Ectobia germanica Steph. Common in stores and houses in towns.

Ischnoptera unicolor Scudd. Occasionally taken at Ames. Specimens were found abundantly in the timber around Oskaloosa in June.

Ischnoptera pennsylvanica DeGeer. Abundant in the timber along the larger streams. Adults during early summer, disappearing by the middle of July.

Periplaneta orientalis Linn. This introduced species, which was formerly confined to a few of the larger cities, has spread over the entire state and is becoming a veritable nuisance, even in the smaller towns of the prairie region.

Periplaneta americana Linn. Specimens of this large southern form have been found at Carbonado, Grand Junction, Little Rock and Ames, but in every case in buildings where bananas were sold, and it is doubtful if they have gained a permanent foothold.

Fam. PHASMIDÆ—Walking Sticks.

Diapheromera femorata Say. Common throughout the timbered portion of the state. Either this or an allied species has been observed very commonly on the prairies of the northwestern portion of the state, during August and September.

Fam. GRYLLIDÆ—Crickets.

Tridactylus apicalis Say. This small species was found rather commonly as nymphs, along the margin of a small stream in August and September, and again the following April. Adults were taken in July.

Gryllotalpa borealis Scudd.

Gryllotalpa columbia Scudd. This and the preceding species are found only in the southern portion of the state. Are they distinct?

Gryllus abbreviatus Serv. The most abundant species in the state occurring everywhere. Sometimes occasions considerable loss in the grain raising sections by cutting the bands of the shocked grain.

Gryllus luctuosus Serv. Rare.

Gryllus pennsylanicus Burm. A few specimens of a broad headed cricket that has been referred here were taken from the timber in July.

Nemobius fasciatus DeGeer. Occurs with abbreviatus in the fields.

Nemobius carolinus Scudd. Common in the woods.

Anaxiphus pulicarius Sauss. A number of these small light colored crickets were taken while sweeping in the woods in July.

Apithes agitator Uhl. One specimen of this southern form has been received from Lee county.

Œcanthus fasciatus Fitch. Abundant everywhere during the latter part of the season.

Œcanthus angustipennis Fitch. Examples of this species appear several weeks earlier than any of *fasciatus*, and may be found rather commonly on the prairie.

Œcanthus niveus Serv. Appears at about the same time as the preceding, but occurs more commonly in the woods.

Œcanthus latipennis Riley. One specimen taken at Ames in September. Probably more common farther south in the state.

Xabea bipunctata DeGeer. Rare.

Fam. LOCUSTIDÆ—Katydids, etc.

Ceuthophilus blatchleyi Scudd. A number found under boards, logs, etc., in July and August.

Ceuthophilus vinculatus Scudd. Common.

Ceuthophilus seclusus Scudd. Rare.

Udeopsylla robusta Hald. Specimens from Little Rock and from the mines of Mahaska county.

Udeopsylla nigra Scudd. Common in holes and cellars.

Pterolepis pachymerus Burm. No specimens have been reported since the former list.

Platyphyllum concavum Say. Rare at Ames.

Amblycorypha oblongifolia Scudd. A few specimens taken each year.

Amblycorypha rotundifolia Scudd. Rather common in the timber, along with the preceding species.

Amblycorypha brachyptera Bruner. Specimens of a much shorter-winged species than either of the above were taken from the prairie of northwestern Iowa some years ago and have been found this season on a few patches of prairie grass at Ames. Professor Bruner has kindly consented to describe it and proposes above name.

Scudderia furculata Brunner.

Scudderia pistillata Bruner. Taken rather commonly from the woods.

Scudderia curvicauda DeGeer. Our most abundant species.

Scudderia furcata Brunner. Common. Smaller than the preceding.

Conocephalus attenuatus Scudd. Common, especially on the prairies.

Conocephalus crepitans Scudd. A single specimen taken at Ames.

Conocephalus ensiger Harr.

Conocephalus nebrascensis Bruner. Fairly common, the brown form is more adundant on the prairies.

Orchelimum nigripes Scudd. Common.

Orchelimum vulgare Harr. Abundant in meadows and low woods where the undergrowth is mainly grasses.

Xiphidium nemorale Scudd. Rather rare.

Xiphidium fasciatum DeGeer. Abundant in meadows everywhere.

Xiphidium attenuatum Scudd. Rare.

Xiphidium brevipenne Scudd. Abundant in low woods and meadows in September and on into October.

Xiphidium nigropleurum Bruner. Rare.

Fam. ACRIDIDÆ—Grasshoppers.

TETTIGINÆ.

Tettix ornatus Say. Abundant in woods and along the margins of the streams.

Tettix arenosus Burm. Common in the timber. More abundant in the early spring than the preceding species.

Tettix granulatus Kirby. This slender form is rather rare.

Paratettix cucullatus Scudd. Adults abundant in the middle of the summer. Larvæ have been taken in the late fall and early spring.

Tettigidea parvipennis Harr. Abundant in low timber land, where the undergrowth is short. The long-winged form, *pennata*, is much more abundant than the other.

TRYXALINÆ.

Pseudopomala brachyptera Scudd. Small larvæ of this species were taken May 12th, and from then until July 3rd, when the last, a full grown female pupa was found. The first adult, a male, was taken June 6th; the first female was taken July 3rd, and the last September 12th. All of these specimens were found on prairie grass principally *Andropogon scoparius.*

Mermiria bivittata Serv. One specimen.

Dichromorpha viridis Scudd. Rather rare. Adult males were taken July 4th and 30th, the females mainly in August.

Eritettix tricarinatus Thos. This species hibernates as nearly full grown larvæ. Adults were first found April 24th and were taken from then until July 4th. Small larvæ were first found the last of August and were abundant throughout the fall until into October. This species was also found on *A. scoparius* and occurred sparingly on the *Bouteloas.*

Orphula speciosa Scudd. Common from July until September as adults on the prairie grasses. Larvæ have been taken from the first of May until July.

Chloealtis conspersa Harr. Adults were taken this season from June 17th until into September, from a moderately shaded pasture.

Stenebothrus curtipennis Harr. Common: occurs at about the same time and in similar situations with *O. æqualis.*

Mecostithus platypterus Scudd. A single specimen collected at Little Rock, Lyon county. Swept from a meadow.

Mecostithus lineatus Scudd. Scott county. (MacNeil.)

Boopedon nubilum Say. Rare. Two specimens taken in July, 1894.

Eremnus scudderi Bruner. Found in abundance on the top of a sandy knoll August 4th, and from then on until the middle of September. The grass on the knoll consisted almost entirely of *B. hirsuta.*

ŒDIPODINÆ.

Chortophaga viridifasciata DeGeer. Adults appear by the 20th of April continuing abundant until the middle of the summer; larvæ appear in August, becoming nearly full grown before winter.

Encoptolophus sordidus Burm. Common on sandy and exposed places throughout the fall.

Arphia xanthoptera Burm. Common in open fields from the middle of August until October.

Arphia carinata Scudd. Common with the preceding.

Arphia conspersa Scudd. Two specimens mentioned in the former list.

Arphia sulphurea Fab. Rather rare. One male was taken May 15th, and another May 23rd.

Hippiscus haldemanni Scudd. Common. Little Rock and Ames.

Hippiscus tuberculatus Pal Beauv. Common in early summer.

Hippiscus variegatus Scudd. Specimens were taken abundantly from the sand knoll from August 20th to September 24th, but were not found anywhere else. Very small larvæ were found with the adults August 20th, so they must have appeared much earlier. The larvæ were about one-third grown by the last of September. The smaller ones had deep red hind tibiæ.

Hippiscus (Xanthippus) zanotecus Sauss. Denison, July 15th; J. A. Allen (Scudder; Psyche 6–392).

Dissosteira carolina Linn. Common.

Spharagemon collare Scudd. Rare.

Spharagemon bolli Scudd. Fairly common along margins of woods and in open places.

Trachyrhachis cincta Thos. Common on sandy places and southern slopes from the middle of July until late in the fall.

Trimerotropis citrina Scudd. Rather rare. Iowa City and Ames.

ACRIDIANÆ.

Brachistola magna Girard. Only found in the western part of the state.

Schistocerca americana Drury. Lee county. Probably occurs throughout the southern part of the state.

Schistocerca alutacea Harr. Isolated individuals have been found from the middle of August on through September.

Schistocerca emarginata Uhl. Common along railway embankments and in hazel brush thickets in August and September. Either a very distinct variety of the above or else another larger species, with bright red or yellow hind tibiæ, and sharply defined black lines under the eyes, was found very commonly in a low marshy place overgrown with willows the last of September.

Hesperotettix pratensis Scudd. Rare. A few examples taken from the sides of the gravel knoll from August 4th to September 3d.

Melanoplus scudderi Uhl. Common in dry open woods in August and September.

Melanoplus occidentalis Bruner. This and the two following species included for the western part of the state on the authority of Professor Bruner.

Melanopus gracilis Bruner.

Melanoplus albus Dodge.

Melanoplus differentialis Thos. Common about roadways and margins of fields. Adults from August through October. Sometimes quite destructive to corn.

Melanoplus bivitattus Say. Common as adults from July till October.

Melanoplus packardi Scudd. One specimen August 1st.

Melanoplus dawsoni Scudd. High open woods. Adults were taken from June 6th until July 7th, this season.

Melanoplus angustipennis Dodge. Iowa City and Ames. Taken from an open woods and along the margin of an adjoining corn field, from the middle of August until the last of September.

Melanoplus minor Scudd. Rare. A few specimens taken August 11th.

Melanoplus punctulatus Scudd. Rare. Des Moines and Ames in September.

Melanoplus femur-rubrum DeGeer. Too common.

Melanoplus luridus Dodge. This species was taken abundantly from the knolls during July and August.

Melanoplus abditum Dodge. This and the following species included on the authority of Professor Bruner.

Melanoplus junius Dodge.

Melanoplus atlanis Riley. Three specimens of this species were taken September 11th from a high gravel point.

Melanoplus spretus Thos. An occasional specimen of this species taken here.

Phoctaloites nebrascensis Thos. Short-winged examples of this unique species fairly common on prairie grass during August and September.

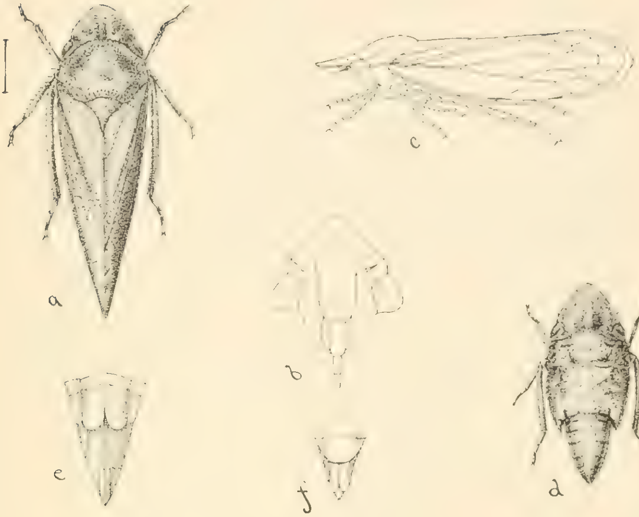


Fig. 1

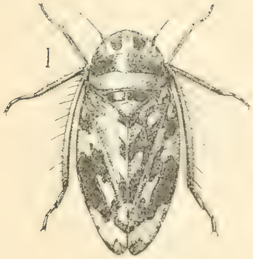


Fig. 2

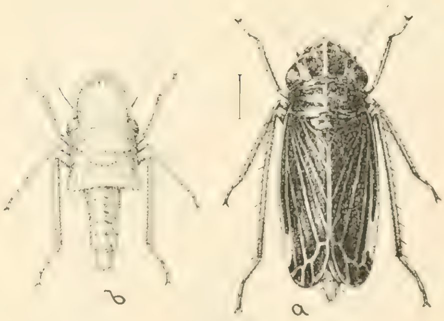
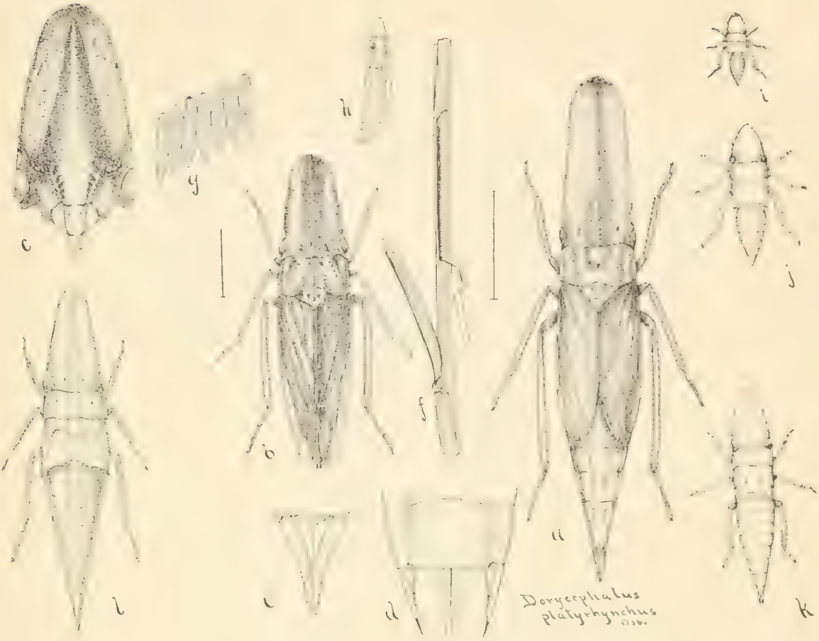


Fig. 3

Fig. 1.—*Xerophloea viridis.* Fig. 2.—*Xestocephalas coronatus.* Fig. 3.—*Euacanthus acuminatus.*



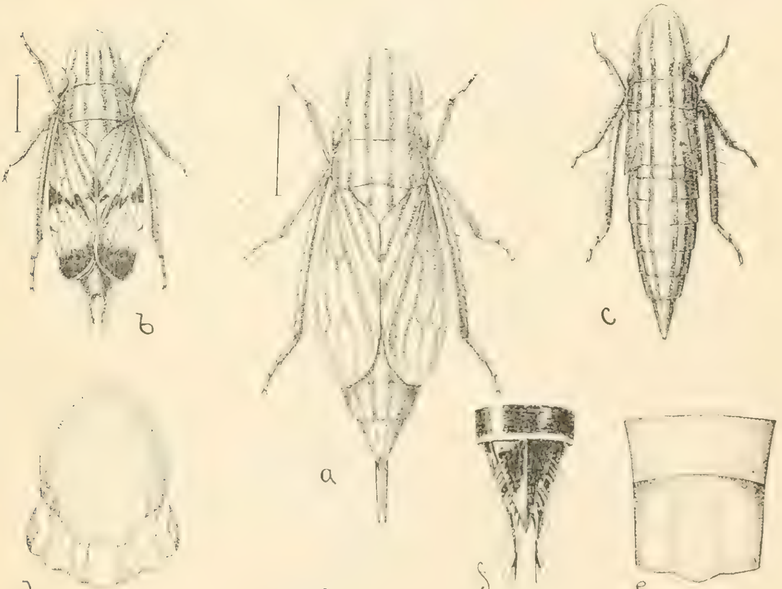
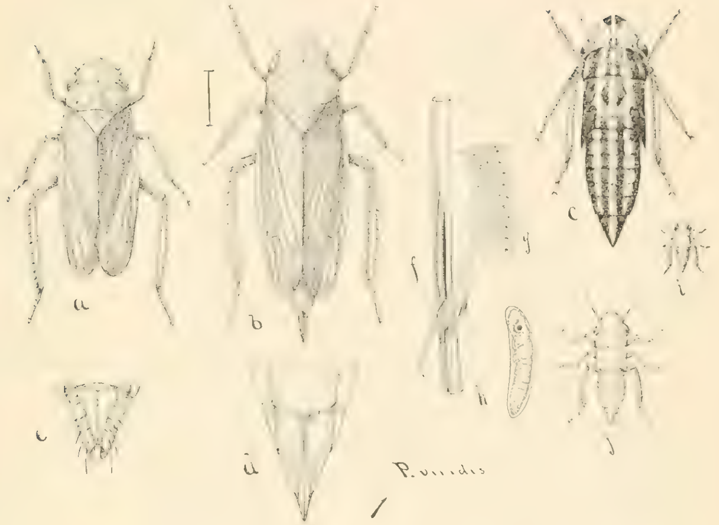


Fig. 2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P. viridis
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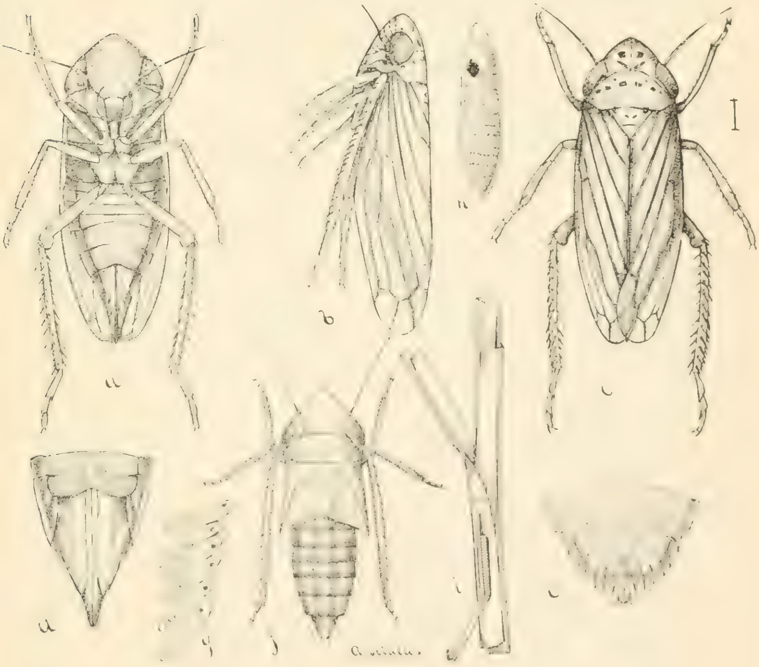
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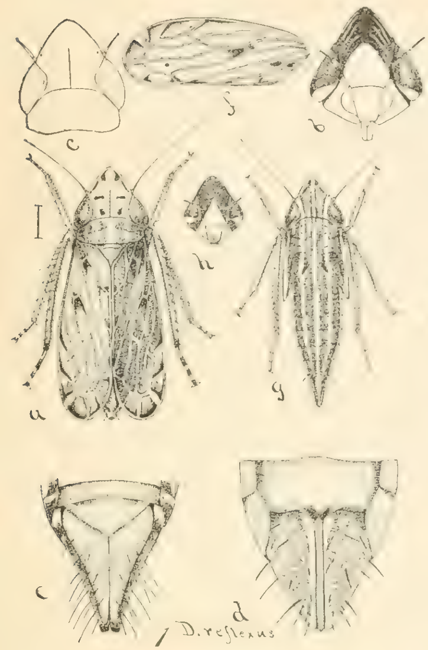
C. vittata



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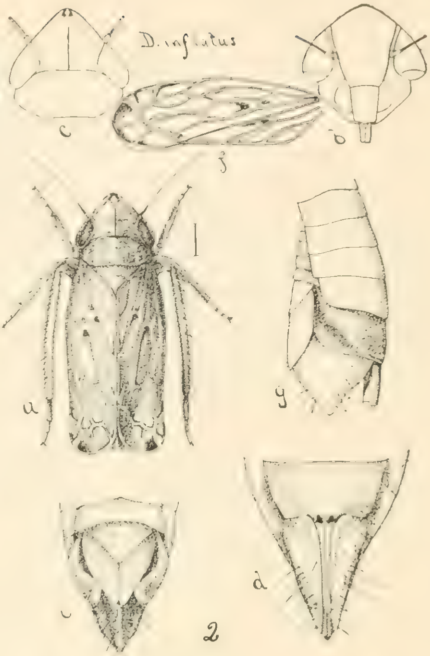

D. inflatus

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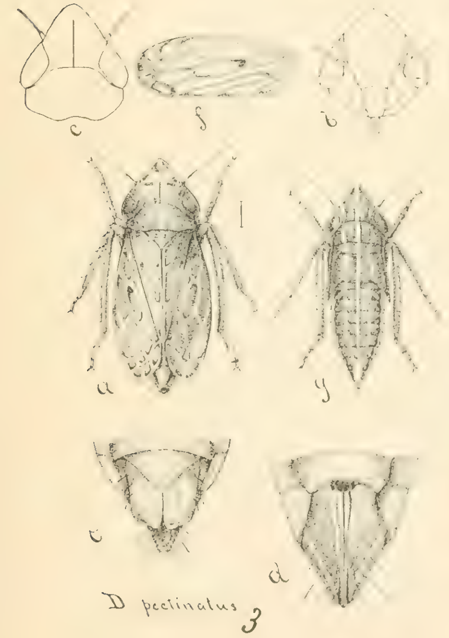
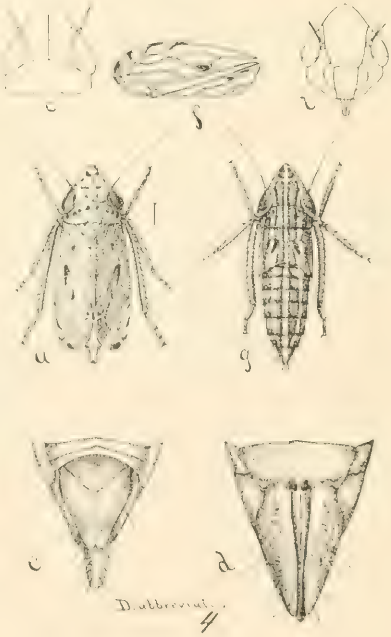


D pectinatus 3



D. abbreviat..

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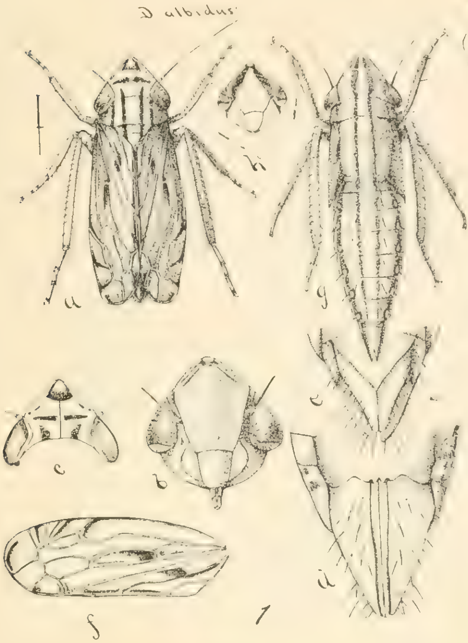
PLATE XXIII.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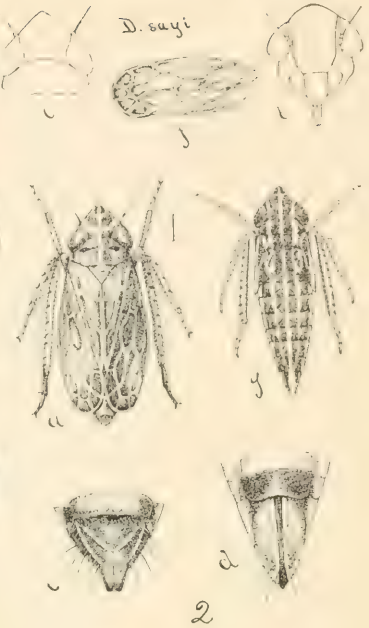
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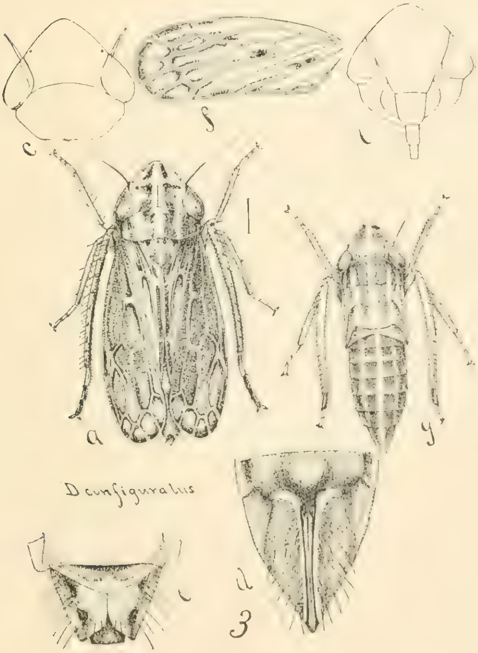
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D. configuratus
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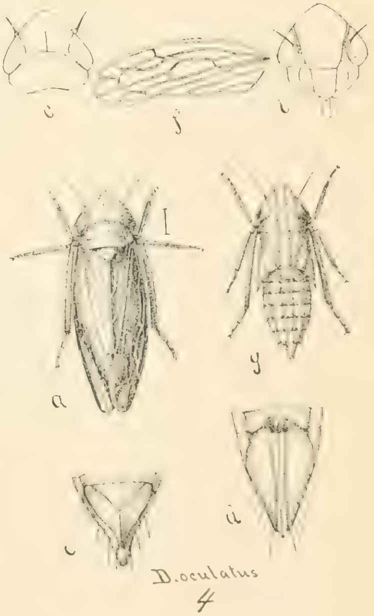
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D. oculatus
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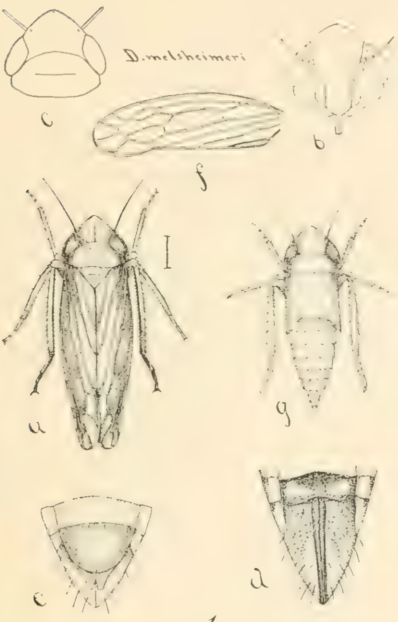

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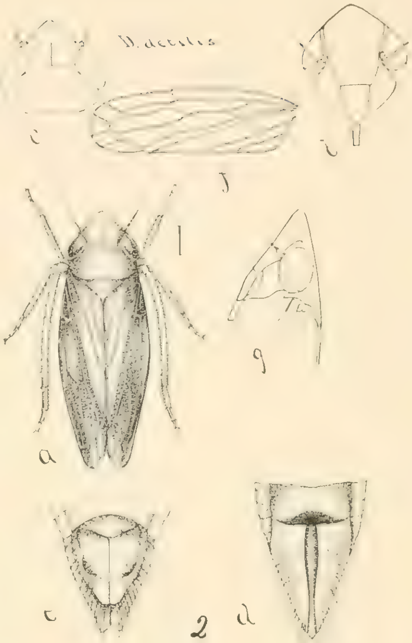

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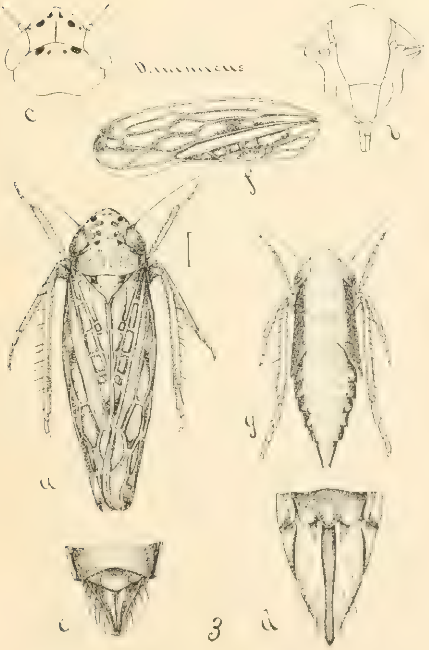

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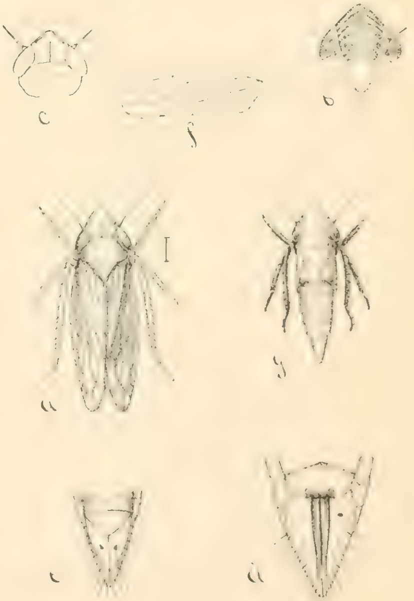

D. minimus

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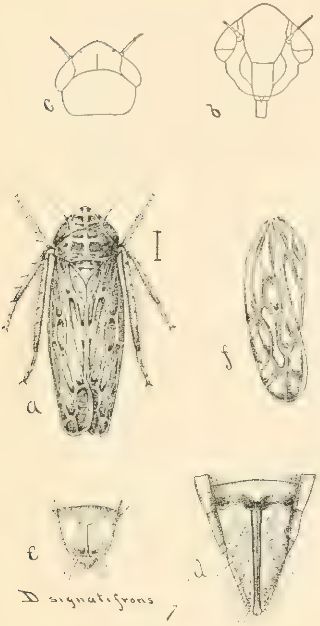

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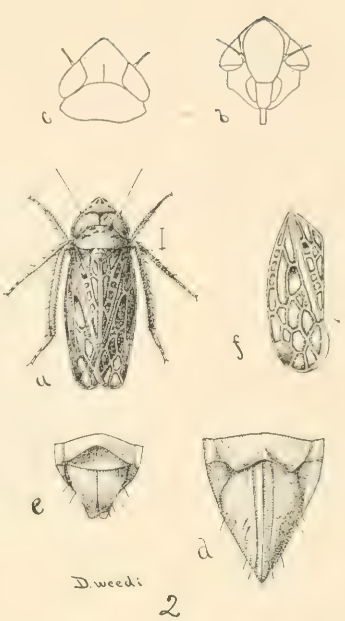
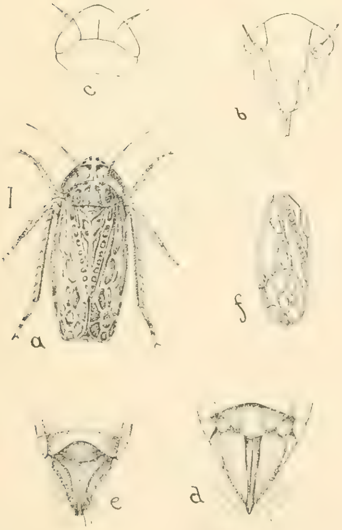
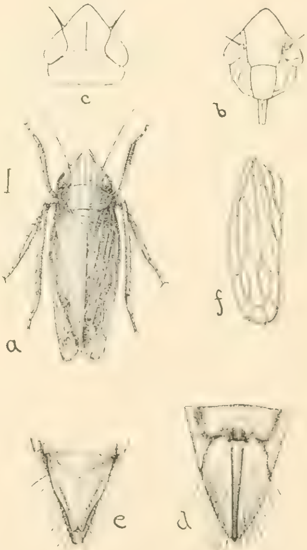


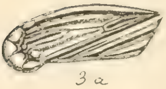
D.weedi 2



3 D compuctus



4 D.sylvestris



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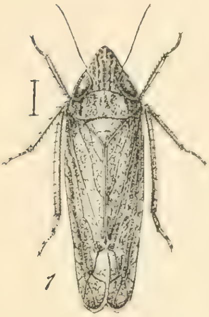

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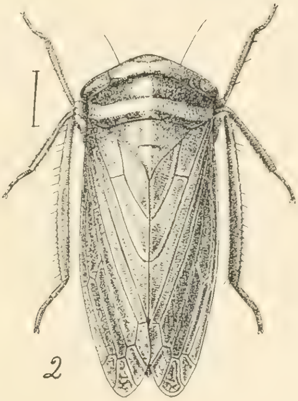

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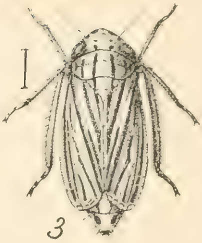

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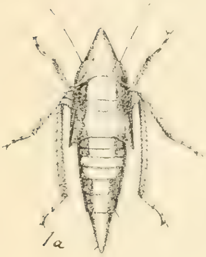

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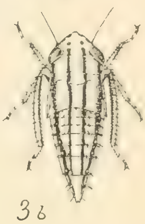

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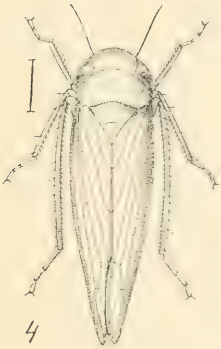

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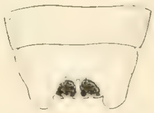

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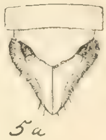

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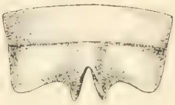

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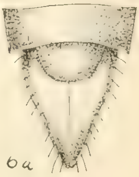

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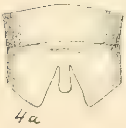

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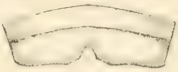

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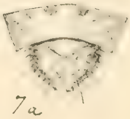

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